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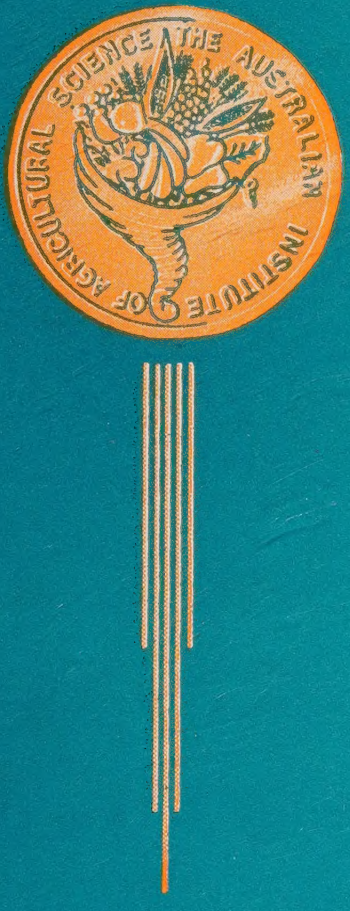

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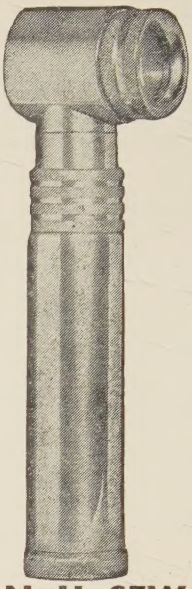

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ARTICLES

SOIL CLASSIFICATION

By E. G. HALLSWORTH and A. B. COSTIN

The recognition of soil types on the basis of their profile characteristics has progressed some way since the early Russian and American systems were developed. The use that can be made of such classifications or of the maps drawn with their aid is at present limited by the lack of definition that has attended the use of certain terms, and by the absence of adequate descriptions of some others. Even today we still lack sufficient analytical data to characterise many of the soil groups to which names have been applied, and it will probably be several years yet before sufficient information has been obtained to show the permitted limits of variation within any one group, which alone will allow a valid distinction being drawn between one soil group and the next.

One of the early distinctions made in subdividing soil groups was to list them under the major headings, of Zonal, Azonal and Intrazonal. This grouping, which had its origin in the Russian plains where climate dominated literally all the other soil-forming factors, does little but express the fact that in areas where topography, parent material, and the floral and faunal complex are not too drastically different, the soils show a weathering pattern that conforms largely to major climatic boundaries.

The analysis of Jenny[1] of the manner in which the various factors control the processes of soil formation presents a much more logical approach to the problem of soil classification. Any soil profile comprises a series of different profiles: the pH profile, the organic matter profile, the texture profile, the carbonate profile, and several others. These will not necessarily all vary in the same manner when any one of the soil-forming factors is changed in one direction. Moreover, a change in one factor leading, for example, to an increased loss of bases from the soil, might well be countered by change in another factor which tends to counteract that loss. Thus, if rainfall is found to increase across a sequence of rocks of increasing base content, the soil formed will tend to be the same, other factors being equal.

Since each of the profiles that constitute the soil unit may vary from maximum to minimum development as we move through a sequence of soil groups, it may be possible to recognise a particular constellation of property profiles as occurring with sufficient frequency to warrant description as a soil group. This is what appears to have been done instinctively rather than deliberately in the development of soil classifications in the past, a notable exception being that proposed by Leeper[2].

The Thorp and Baldwin Classification

The widely used classification of Thorp and Baldwin, however, uses features other than profile features to distinguish the various groupings, and whilst such procedure may be valid in a region in which the soil-forming factors vary in

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a constant manner, it raises difficulties in comparing the soils of two regions where a soil-forming factor in one region may be totally unlike its counterpart in the other region. Stephens[5] has recently drawn attention to this in discussing the role of the botanical component in the development of the podzolic soils of this country and overseas.

Stephens' Classification

An alternative classification has been put forward by Stephens[6] for use in the compilation of a soil map of Australia. Although it is a welcome advance on that proposed by Thorp and Baldwin, in the opinion of the authors the groupings and nomenclature suggested leave something to be desired. At the moment no alternative is offered for the groupings into higher categories, but it is suggested that it would be sufficient at present if an adequate description of the major soil groups, their sub-groups, and profile variants were available.

Stephens' classification lists two soil Orders, pedocals and pedalfers. He then recognises four Sub-orders in the pedalferic group and three in the pedocalic group. These are split further in his fourth category of Great Soil Groups. Our objections are twofold. Firstly, the proposed Sub-orders both obscure unnecessarily the affinities of certain closely related soils, and by their very definition are not always applicable to some of the Great Soil Groups included in them. Secondly, the proposed list of Great Soil Groups not only contains certain confusing terms which can be improved upon, but also omits several important soils known by the authors to occur in Australia.

Our major objections are to the proposed Sub-orders. Considering them as (1) to (7) in the order given by Stephens, they are as follows:

Sub-order 1 *Acid organic soils*

This group separates the peats from the closely related fens (Sub-order 5), whilst the group "Swamps" requires expansion.

Sub-order 2 *Acid soils with organic and sesquioxide illuvial horizons*

This heading fits only the groundwater podzols and the humus podzols. It does not accommodate those podzols in which sesquioxide has accumulated without concomitant accumulation of humus (e.g., about half of those described by Robinson *et al*[4]).

Sub-order 3 *Acid soils with sesquioxide and clay illuvial horizons*

This description seems satisfactory for most groups but less so for Residual Lateritic and Sand Plain-Podzols, in which the podzol horizon may not be part of the original laterite profile, but possibly due to subsequent leaching during a cooler climate in the Pleistocene. The soil group in this case would be podzol, the parent material for the later podzolising process being laterite rather than the underlying rock. We have also observed in the Southern Tablelands of New South Wales the occurrence of several superimposed laterite profiles. In such localities, truncation of the upper ferruginous and mottled horizons to the underlying pallid zone and the subsequent development of organic matter in the surface soil gives a profile which superficially resembles a podzol profile.

Sub-order 4 *Acid to neutral soils with sesquioxide and clay eluvial and illuvial horizons*

The meaning of this heading is obscure. Does it mean that the sesquioxide and clay have been eluviated and deposited in the illuvial horizon, or does it mean that the whole profile is rich in clay and sesquioxides? It is possible to doubt that in a red loam there is any illuvial horizon, the eluviated material having washed out in the drainage water.

A second query concerns the difference between the terms Lateritic Red Earth and Lateritic Red Loam. Are these meant to be residual soils or are they soils forming today? If the former is the case, why apply the term "Residual" to the Lateritic and Sand Plain Podzol (Sub-

order 3) and not to the Lateritic Red Earth and Lateritic Red Loam?

Sub-order 5 *Soils largely with neutral organic eluvial and neutral or calcareous illuvial horizons*

The use of the term "organic" in this connection is surprising. Can one use the same term to describe the organic matter content of both the Black Earths and the Moor Peats (Sub-order 1)? Moreover, Stephens[5] himself has suggested that the Black Earths and Chernozems should be separated on the basis of their organic matter content.

The grouping of Solonetz, Solonchak and Soloth all as soils with neutral organic eluvial horizons also occasions surprise. If these soils can be described as organic in this way, there seems little point in using the term. Moreover, the solodized-solonetz and soloth soils may be highly acidic in the surface.

Sub-order 6 *Soils with neutral eluvial and neutral or calcareous illuvial horizons*

The main difference between the soils of this group and the one preceding it is apparently the quantity of organic matter in the surface horizon. In northern New South Wales at least this distinction is not valid, since the organic matter of the surface soil is as high in the Red-brown Earths as it is in black soils (whether Black Earth or Chernozem). Moreover the Red-brown Earth and Brown Earth soils may be quite acid in the surface and may lack the calcareous horizon, e.g., in West Australia, on the Bathurst Plains in New South Wales, or in most Red-brown Earths developed on granite in south western New South Wales.

The Brown Soils of Light Texture are described by Prescott[3] as having "surface horizons which are usually somewhat acid in reaction," and our own figures would completely support this statement.

The separation of the Brown Soils of Heavy Texture from the Grey Soils of Heavy Texture seems unfortunate, since they frequently occur in close topographic association, as, for example, in the Namoi region of New South Wales where Brown and Grey Soils occur respectively on the ridges and in the hollows. These soils, furthermore, carry a gypseous horizon, and consequently should not be included in this Sub-order. There is a real need for a name to describe the Grey and Brown Soils of Heavy Texture. The name Sierozem suggests itself, since in the English language at least it does not necessarily connote desert conditions.

The inclusion of the Solonized Brown Soils in this Sub-order is also questionable, since they may also contain subsoil gypsum, as, for example, in the West Darling Region.

Sub-order 7 *Soils with neutral to alkaline eluvial and calcareous and gypseous illuvial horizons—profiles deflated to varying degrees*

The main point with which we would take issue here concerns the implication that these soils are related to each other by the extent of deflation. In our view they are not, but this has been considered elsewhere.

The inclusion of the two terms Desert Loams and Red Calcareous Desert Soils appears to be redundant.

The Great Soil Groups

Our second group of objections concerns the terms used by Stephens for the individual members of the Great Soil Groups. These have not all been defined, nor does there exist complete agreement as to what are the essential features of some of the groups. The use of the term Brown Earth by Stephens to denote a profile differing in important respects from those originally described by the term in Europe is a case in point. Additional groups to those given by Stephens are also known to exist in Australia, some of which have not yet been described in the literature.

In the development of a system of classification, it might be desirable to restrict the number of Great Soil Groups considered, and to list as Sub-groups those

which only vary to a small extent one from the other, and which show a certain uniformity in profile features. The points at which such divisions are made will, of course, always be a matter of opinion. For more detailed work, significant Profile Variants may also be recognised within the permissible range of variation of the Great Soil Groups and Sub-groups themselves.

An Alternative Arrangement of these Groups

An alternative arrangement of the Great Soil Groups, together with their Sub-groups and certain permissible Profile Variants, is presented for criticism in the following table. In most cases existing names have been used, although these admittedly have many imperfections. This table summarises the conclusions of some of the work undertaken from these laboratories, and is intended as an introductory statement. A more detailed account will be published later of those soils which have not been described earlier for this country.

A LIST OF SOIL GROUPS KNOWN TO OCCUR IN AUSTRALIA

GREAT SOIL GROUP	SUB-GROUPS	PROFILE VARIANTS
Soils showing no profile differentiation. Largely mineral in character.		
1. Lithosols		
2. Regosols	Aeolian Regosol	
	Fluvial Regosol	
Soils in which the profile is dominated by organic matter, of which the botanical features are partially visible.		
3. Dry Peats		Dry Peat Podzol
4. Fen Peats	Rich Fen Peat	
	Poor Fen Peat	
	(eq. Acid Lowmoor Peat)	
5. Bog Peats	Valley Bog Peat	Valley Bog Gley Podzol
	Raised Bog Peat	Raised Bog Gley Podzol
	Blanket Bog Peat	
	(apparently not present in Australia)	
6. Humified Peats		
Soils in which ground water is present in the solum for at least part of the year.		
7. Silty Bog Soils		Silty Bog Gley Podzol
8. Gley Podzols (eq. Ground Water Podzols)		
9. Meadow Soils	Normal Meadow Soil	Meadow Gley Podzol
	Snow Patch Meadow Soil	
	Calcareous Meadow Soil	
10. Marsh Soils	Normal Marsh Soil	
	Salt Marsh Soil	
11. Alluvial Soils		
12. Laterite (eq. Ground Water Laterite)		

GREAT SOIL GROUP	SUB-GROUPS	PROFILE VARIANTS
Soils in which the profile shows eluviation of the sesquioxides and sometimes of clay also. Acid to strongly acid in the surface.		
13. Podzols	Humus Podzol Iron Podzol	
14. Brown Podzolic Soils (eq. Concealed Podzols)		
15. Grey-Brown Podzolic Soils		
16. Yellow Podzolic Soils		
17. Red Podzolic Soils		
Soils in which the profile shows no eluviation of sesquioxides or clay. Acid to strongly acid in the surface.		
18. Alpine Humus Soils		
19. Transitional Alpine Humus Soils (eq. Sod Forest Soils)		
20. Red Loams (eq. Kraznozems, Latosols)		
Soils in which the profile shows no eluviation of sesquioxides. Slightly acid to neutral in the surface.		
21. Prairie Soils		
22. Chocolate Soils	Grey Chocolate Soil Normal Chocolate Soil Reddish Chocolate Soil	
23. Brown Earths (eq. Braunerde)	Brown Forest Soil Brown Meadow Soil Colluvial Brown Earth Brown Limestone Soil	
24. Rendzina		
25. Terra Rossa		
26. Brown Soils of Light Texture		
Soils in which the profile shows eluviation of clay, but little or no eluviation of sesquioxides. Acid in the surface.		
27. Non-calcerous Red-brown Earths (eq. Shantung Brown Soils Non-calcic Brown Soils)	Podsolized Red-brown Earth	
Soils in which the profile shows eluviation of clay, and an illuvial horizon of calcium carbonate. No gypsum.		
28. Red-brown Earths	Solodized Red-brown Earth	
29. Calcareous Brown Earths (eq. Brown Earths of Stephens)		

GREAT SOIL GROUP	SUB-GROUPS	PROFILE VARIANTS
Soils in which the profile shows no eluviation of clay, but an illuvial horizon of calcium carbonate. No gypsum.		
30. Chernozem	Brown Chernozem Black Chernozem Degraded Chernozem Brown Chernozemic Soil (eq. Chernozem-like Soils) Black Chernozemic Soil	
Soils in which the profile shows no eluviation of clay, but illuvial horizons of calcium carbonate and gypsum.		
31. Sierozem	Brown Sierozem (eq. Brown Soil of Heavy Texture) Solonized Brown Sierozem Grey Sierozem (eq. Grey Soil of Heavy Texture)	
Soils in which the profile shows eluviation of clay, and illuvial horizons of calcium carbonate and gypsum.		
32. Solonized Brown Soils 33. Solonetz 34. Solod (eq. Soloth) 35. Seif Dune Soils (eq. Desert Sandhills of Prescott) 36. Stony Downs (eq. Stony Desert Soils, Stony Gilgai) 37. Desert Loams 38. Salty Alkali Soils (eq. Takyr-like Soils)	Solodized-solonetz	
Soils showing no eluviation of clay owing to flocculation by high content of soluble salts.		
39. Saline Soils or Solonchak		

References

1. Jenny, H. (1941).—"Factors of Soil Formation A System of Quantitative Pedology." (McGraw-Hill: New York and London).
2. Leeper, G. W. (1948).—"Introduction to Soil Science." (Melbourne University Press: Melbourne.)
3. Prescott, J. A. (1944).—"A Soil Map of Australia," C.S.I.R. Aust. Bull. No. 177.
4. Robinson, G. W., Hughes, D. O., and Roberts, E. (1949).—"Podzolic Soils of Wales," *J. Soil Sci.*, **1**: 50.
5. Stephens, C. G. (1950).—"Comparative Morphology and Genetic Relationships of Certain Australian, North American, and European Soils," *J. Soil Sci.*, **1**: 123.
6. Stephens, C. G. (1950).—"A Mapping System for the Compilation of a Soil Map of Australia. A System Based on the Taxonomy of the Great Soil Groups." *J. Aust. Inst. Agric. Sci.*, **16**: 10.

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A SEARCH FOR RESISTANCE TO DEFOLIATION BY ALTERNARIA SOLANI IN THE GENUS LYCOPERSICON

By R. D. BROCK

Introduction

In Australia, considerable economic loss is caused by the defoliating diseases of tomatoes; of these Early Blight or Target Spot, caused by the fungus of *Alternaria solani* (Ell and G. Martin) Sor., is widespread and considered the most important. This disease occurs in late summer and autumn and at any stage of the plant's growth, but is worst as plants approach maturity. Defoliation which reduces yield and quality of fruit is the most important phase of the disease in Australia. The stem girdling or Collar Rot phase of the disease on seedlings usually occurs in the tropical and sub-tropical areas but is of little importance in the south. Because of the lack of adequate control measures it was decided to try to find plants within the genus *Lycopersicon*, which could be used as parental material to breed a commercial variety resistant to defoliation by *Alternaria solani*.

Bonde[2] reported strains of *Alternaria solani* varying in their pathogenicity on tomato seedlings, thus some pathogenicity studies on isolates of the organism were considered necessary before a search for resistance could be made.

Materials and Method

The method of artificial inoculation presented here differs from those reported by Wellman[7], Andrus, Reynard and Wade[1] and Locke[3] in that spray inoculation of a mycelial suspension was used to infect the plants.

The spray inoculation was chosen as the routine method because it is more convenient for large-scale inoculations. The use of a mycelial suspension, rather than spores, as a source of infection, is necessary because it is difficult to produce large quantities of spores of *Alternaria solani* by normal cultural methods. Although special methods have been developed to induce sporulation (Rand[5], McCallan and Shuk Yee Chan[4]), these methods do not readily produce the large number of spores required. The fungus was isolated from diseased plants and grown on potato dextrose agar for five days at 27°C. Standard discs, 10 mm. in diameter, were used to seed 100 cc. of modified Tochinai solution (Wellman[6]). After incubation for 14 days at 27°C. the fungal mat and media were macerated in a high speed electric blender for three minutes. Sixty tomato seedlings were sprayed with 100 cc. of mycelial suspension from a hand atomiser and this was the standard test for any one variety or fungal isolate.

The post-inoculation environmental conditions were found to have a marked effect on the development of the disease. Satisfactory disease development occurred when the plants were held in a

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humidity chamber at 90 to 100 per cent. relative humidity for three days, then removed to the glasshouse bench for another three days. Mean temperatures for the three days in the humidity chamber in successful inoculations ranged from 19.1°C. to 28.5°C.; with the minimum temperature recorded 11.1°C. and the maximum 35.7°C.

As the micro-environment was considered important, a standard procedure was adopted with the plants to be inoculated. Seedlings were pricked out into standard flats two feet by one foot, in ten rows of six plants. As plants which were slightly larger or smaller than the normal were not removed, it was necessary, when rating the plants, to make allowance for slightly different stages of maturity. A rating scale was used which gave a numerical rating from 0 to 10 for the extent of damage to each plant. Plants rated 0 had no infection and plants rated 10 had all leaves defoliated and the terminal bud killed. The measurement of the damage to the plant was based primarily upon defoliation, but where no defoliation occurred it was based upon an estimate of the necrotic area of the leaves. Where defoliation occurred the rating scale was found to be sufficiently accurate without taking into account the necrotic areas on the remaining leaves. The numerical rating given on these criteria was further dependent upon the stage of maturity of the plant which was expressed by the number of expanded leaves. Where the terminal leaf was less than half an inch in length it was not regarded as an expanded leaf but as the terminal bud. While the majority of the plants rated had either five or six expanded leaves, provision was made for the rating of plants which had from four to seven expanded leaves.

Pathogenicity tests of *Alternaria solani* isolates

Twelve pathogenic isolates of *Alternaria solani* were made over a wide geographic range and from the hosts, tomato (*Lycopersicon esculentum Mill.*), potato (*Solanum tuberosum* L.) and nightshade (*Solanum nigrum* L.). These isolates were maintained in culture on potato dextrose agar and tested for pathogenicity on tomatoes and potatoes. The results of one pathogenicity test of these isolates on tomatoes and potatoes is presented in Table I. As will be seen there is a range of pathogenicity between the various isolates and the order of pathogenecity is not the same for the two hosts.

In six tests on tomatoes and three on potatoes the isolates S-2, S-23 and S-35 consistently showed a high level of pathogenicity on both hosts. The remaining isolates varied on different occasions and statistical examination of these results showed that there was a real shift of virulence on the different occasions. This suggested that the field isolates may consist of mixtures of strains of different pathogenicity. Single spore isolations made from two of the field isolates, S-23 and S-46, and tested for pathogenicity on tomatoes showed that each of

TABLE I

Relative pathogenicity of field isolates of Alternaria solani on tomatoes and potatoes in one test on each host.

Isolate No.	Mean rating of plants six days after inoculation	
	Tomato	Potato
S-2	7.6	9.0
S-9	4.5	8.6
S-16	7.6	8.0
S-23	8.0	9.2
S-35	7.5	8.8
S-46	6.1	2.4
S-51	8.7	2.8
S-90	9.3	2.6
S-91	6.6	8.2
S-93	5.8	6.0
S-95	6.6	6.4
S-105	7.1	8.8
Minimum difference for significance at 5 per cent.	0.4	1.7

these isolates contained at least two strains of different pathogenicity. Although no detailed measurements were made there were no obvious cultural or morphological differences between the single spore isolates of different pathogenicity.

The notable differences in pathogenicity of the cultures when tested on tomatoes and potatoes were in the isolates S-51 and S-90 which were consistently high on tomatoes and low on potatoes and S-9 which was low on tomatoes and high on potatoes. These differences suggest that certain strains of the organism may be favoured by one or other of the hosts. To check this, cross inoculations were made using two of the field isolates. In each of these tests, after disease development on the host plant, the fungus was re-isolated for the next inoculation. Each isolate was inoculated to, and re-isolated from, the following hosts:—

(a) Five successive inoculations to tomatoes.

(b) Five successive inoculations to potatoes.

(c) After one inoculation to tomatoes, four successive inoculations to potatoes.

(d) After one inoculation to potatoes, four successive inoculations to tomatoes.

After each re-isolation, pathogenicity tests were made with the isolate on tomatoes and potatoes. The results of these tests showed that successive passages through one host had no effect on the pathogenecity of the isolate on either host.

Search for resistance

Efforts were made to locate any resistant lines which would be useful for breeding; for this reason the search was confined to the genus *Lycopersicon*. The inoculation method used causes much greater defoliation of the seedlings than would normally occur in the field. This rigorous testing of seedlings was considered necessary in such a search for resistance in view of the necessity of locating a high degree of resistance to warrant the establishment of a breeding programme.

It was not practicable to test all the available material at the one time, so the susceptible variety Bonny Best was used as the check variety. At each inoculation the reactions of 60 plants of each of nine lines under test and 60 Bonny Best plants were examined. The overall mean rating of the Bonny Best plants was 7.06 and the mean ratings in each of the separate inoculations varied from 4.8 to 10.0. On the occasions where a low rating occurred on the check plants the tests were repeated. The inoculum used in the search for resistance was a mixture of the isolates S-2, S-23, S-35, S-51 and S-90.

The following species and varieties of *Lycopersicon* were tested for resistance to defoliation by *Alternaria solani*:—

Lycopersicon esculentum Mill. (109 varieties).

Adelaide Dwarf Red
Australian Large Red
Bison
Bonnimar
Bounty
Break-o-Day
Burpee Globe
Burpee Hybrid
Burwood Prize
Burwood Wonder
Clinton Hybrid
Cluseed No. 99
Coburg
Coventry
Danish Export
Denisonia
Denmark
Devlins Choice
Dobbie's Melville Castle
Dwarf Stone
Earliana
Earliwinner
Early Chatham
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Fordhook Hybrid	Rutgers 308
Garden State	San Marzano
Garrow	Santa Clara Canner
German Sugar	Sensation
Glostone	Sioux
Gloriana	Stemless Pennorange
Golden Queen	Stemless Pennred
Greater Baltimore	Stemfructifera
Grosse Lisse	Stokesdale
Grothens Globe	Stoner's Dwarf Gem
Gusave A.	Stone
Gurnsey Beauty	Table Talk
Gulf State Market	Tatinter
Hout Bay	Tatura Dwarf Globe
Hundredfold	Turrialba
Improved Morses 133-6	Valiant
Improved Stone	Victor
Indiana Baltimore	Victorian Dwarf
J.T.D.	Walker's Recruit
Jubilee	Wanneroo Early
Komet	Wanneroo Late
Le Jeune	Wasatch Beauty
Livingston's Globe	Washtate
Marglobe	Zaria
Market King	Zaria X Komet
Matchless	

Lycopersicon esculentum var. *cerasiforme* (Dun.) A. Gray.

Native tomato from New Guinea.

Lycopersicon pimpinellifolium (Jusl.) Mill.

17 lines from various sources.

Lycopersicon peruvianum (L.) Mill.

20 lines from various sources.

Lycopersicon peruvianum var. *dentatum* Dun.

1 line.

Lycopersicon hirsutum Humb. and Bonpl.

2 lines.

Although several varieties included above have been reported as having some resistance to the disease, none of the varieties showed any significant resistance to defoliation under the conditions of testing. Some variation in the reaction of the varieties was observed although none would be suitable for use in a breeding programme.

The lines of *L. pimpinellifolium, L. peruvianum* and *L. hirsutum* tested showed no resistance to defoliation. A range of reactions was observed but none of these lines would be suitable for breeding for resistance. In these lines the defoliation was heavier than in most of the *L. esculentum* varieties.

The reactions of all of the lines of *L. pimpinellifolium, L. peruvianum* and *L. hirsutum* and many of the varieties of *L. esculentum* were confirmed by observations in the field at Canberra during the three consecutive seasons 1948 to 1950.

From the resuts of the artificial inoculations and field observations, it is apparent that the field reaction to the disease is a combination of the inherent reaction of the plant, as revealed by the artificial inoculation described, and the growth habit of the plant through its effect on the micro-environment of the leaves. Plants making dense bushy growth provide a more favourable microenvironment for the development of the disease than plants with an open spreading type of growth.

Summary

This paper reports a method of measuring the inherent reaction by artificial inoculation as distinct from the field reaction, of tomato plants to *Alternaria solani*. Artificial inoculation is done by spraying seedlings with a mycelial suspension of the fungus.

Field isolates of the organism varied in pathogenicity on tomatoes and potatoes. Certain of the isolates proved to be a mixture of strains of different pathogenicity. Cross inoculation tests to tomatoes and potatoes showed that pathogenicity on either host was not affected by passage through the alternate host.

No resistance to defoliation by *Alternaria solani* was located in species and varieties of the genus *Lycopersicon* tested. Tests covered one hundred and ten varieties of *L. esculentum*, seventeen lines of *L. pimpinellifolium*, twenty lines of *L. peruvianum* and two lines of *L. hirsutum*.

Acknowledgments

Grateful acknowledgment is made to the following members of the Division of Plant Industry, C.S.I.R.O.—Mr. E. M.

Hutton for helpful advice, Miss G. M. Roberts and Mr. R. R. Rochford for valuable technical assistance. Mr. G. A. McIntyre, Section of Mathematical Statistics, C.S.I.R.O., gave statistical advice and assistance.

References

1. Andrus, C. F., Reynard, G. B., and Wade, B. L. (1943).—Relative resistance of tomato varieties, selections and crosses to defoliation by *Alternaria* and *Stemphylium*. U.S.D.A. Circular No. 652. pp. 23.
2. Bonde, R. (1929).—Physiological strains of *Alternaria solani*. *Phytopathology* **19**: 533-548.
3. Locke, S. B. (1948).—A method for measuring resistance to defoliation diseases in tomato and other *Lycopersicon* species. *Phytopathology* **38**: 937-942.
4. McCallan, S. E. A., and Shuk Yee Chan (1944).—Induced sporulation of *Alternaria solani*. Contrib. from Boyce Thompson Institute, **13**: 323-335.
5. Rands, R. D. (1917).—The production of spores by *Alternaria solani* in pure culture. *Phytopathology* **7**: 316-317.
6. Wellman, F. L. (1939).—A technique for studying host resistance and pathogenicity in tomato fusarium wilt. *Phytopathology* **29**: 945-956.
7. Wellman, F. L. (1943). — A technique to compare virulence of isolates of *Alternaria solani* on tomato leaflets. *Phytopathology* **33**: 698-706.

(*Received for publication, May* 15, 1950.)

ERRATA

Volume 16, No. 2, June, 1950

Page 43—Contents; W. G. Harris, should read—W. B. Harris.

Page 60—Line 26; usually, should read—rarely.

Page 69—Caption to Figs. 1 and 2 should read:—
Uncintured Zante Currants (right) sprayed with parachlorophenoxy acetic acid compared with distilled water sprayed bunches (left).

Page 72—The treatments in Table I should read:—

Treatment	No. of figs in test	% Set	Mean Weight on 9/1/50 in grams
2,4,5 tri chloro phenoxy acetic acid 50 p.p.m.	25	60.0	6.65
Isopropyl ester of 2,4,5,T 50 p.p.m.	25	62.5	9.06
B. Indole butyric acid 450 p.p.m.	25	88.8	9.66
P. chloro phenoxy acetic acid 1500 p.p.m.	25	77.7	11.04
2,4, dichloro phenoxy acetic acid 150 p.p.m.	12	60.0	3.9
2,4, dichloro phenoxy acetic acid 250 p.p.m.	13	100.0	8.8
Caprified	25	100.0	17.0
Control, distilled water	14	0	3.86

FREQUENCY OF IRRIGATION FOR TOMATO PLANTS

By J. E. GILES and D. McE. ALEXANDER

In the Mildura district tomatoes are grown on a wide range of soil types, with a preference for the sandy soils of which Barmera sand[1] is an extensive type. The aim of this experiment was to determine the best frequency of irrigation for furrow-irrigated tomato plants grown on a Barmera sand. The trials were conducted at Red Cliffs, Victoria, in the seasons 1945-46, 1947-48 and 1948-49.

Experimental Procedure

At each irrigation the soil was wetted to field capacity to a depth of between three and four feet by maintaining water for approximately four and a half hours in furrows spaced from two feet to two feet six inches apart.

For the 1945-46 season, the Adelaide Dwarf Red variety was used and two treatments were applied—irrigation at intervals of one week and of three weeks. In the 1947-48 season, the number of treatments was increased to four—irrigation at frequencies of one, three, four and five weeks with two varieties—Pearson 29-17 (a popular variety in the district) and an advanced Fusarium wilt resistant hybrid (Rouge de Marmande x Pan America).

For the 1948-49 season, the frequencies were based on evaporation to allow for weather conditions. The evaporation was determined from an exposed free water surface by a standard meteorological evaporimeter installed at the Commonwealth Research Station, Merbein, and can be considered representative of the district.

In the Mildura district, the months of the greatest amount of evaporation are November, December, January and February. The average daily evaporation for each of these months over the last eighteen years is 0.24, 0.28, 0.29 and 0.24 inches respectively. For this season, therefore, water was applied at three frequencies, based on evaporation of approximately 2, 6-7, 7-8 inches respectively between irrigations; and a fourth frequency based on the wilting point of the soil as indicated by the plants.

Systems of randomised plots were used throughout with at least six replications. Each plot consisted of 33 plants, planted in rows five feet apart with three feet between plants.

In the 1945-46 season, seedlings were transplanted out during the third week in November, and in the other seasons during the third week in October. Plants were lightly watered when considered necessary until well established (usually about six weeks) after which treatments commenced. Similar fertilizer and cultural treatments were applied each season. The fertilizer applied was a 3:1 mixture of superphosphate and sulphate of ammonia at the rate of one ounce per plant.

Data obtained included soil moistures, health of plants, yield, maturity, root growth and root distribution.

J. E. GILES, is a Senior Technical Officer and D. McE. ALEXANDER, B.Sc., is a Research Officer, both of the Commonwealth Scientific and Industrial Research Organization. They are at present at the Commonwealth Research Station, Merbein, Victoria.

Results

Soil Moisture

Soil moistures were determined at weekly intervals at depths of 4-6 and 16-18 inches for the 1945-46 and 1947-48 seasons, and at various dates at depths of 3-9 and 9-18 inches for the 1948-49 season.

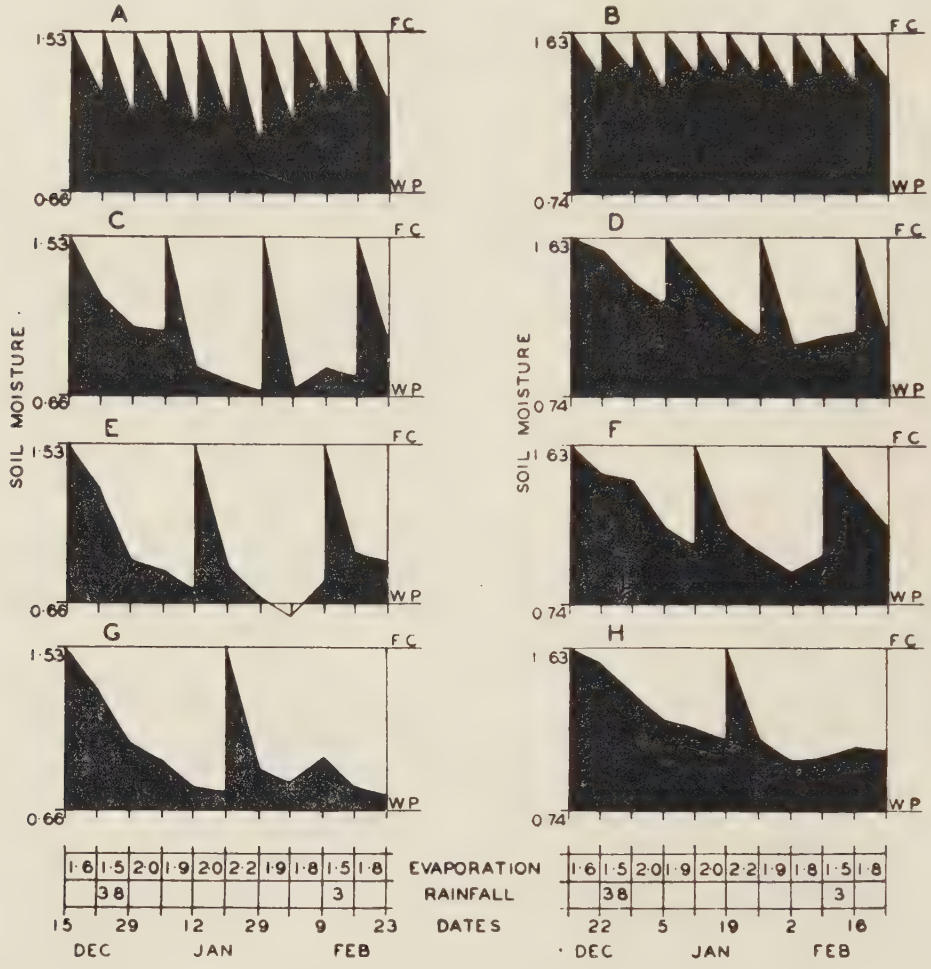

Figure 1.
Soil Moisture Fluctuations at Weekly Intervals at Depths of 4-6 and 16-18 inches for Four Irrigation Frequencies. 1947-48 Season.

FC: Field Capacity WP: Wilting Point.

A:	Irrigation	at	intervals	of	1	week	— Depth:	4–6	in.
B:	,,	,,	,,	,,	1	,,	— ,,	16–18	,,
C:	,,	,,	,,	,,	3	,,	— ,,	4–6	,,
D:	,,	,,	,,	,,	3	,,	— ,,	16–18	,,
E:	,,	,,	,,	,,	4	,,	— ,,	4–6	,,
F:	,,	,,	,,	,,	4	,,	— ,,	16–18	,,
G:	,,	,,	,,	,,	5	,,	— ,,	4–6	,,
H:	,,	,,	,,	,,	5	,,	— ,,	16–18	,,

Note:—Between the period February 2nd and 9th there is shown a rise in soil moisture. This can only be explained as due to experimental error, but has little effect on the general moisture fluctuations.

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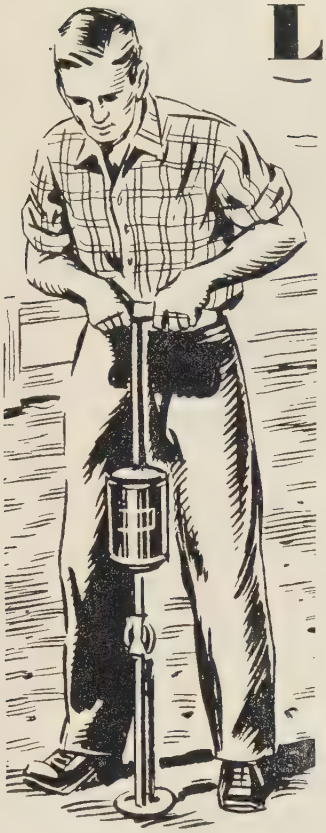

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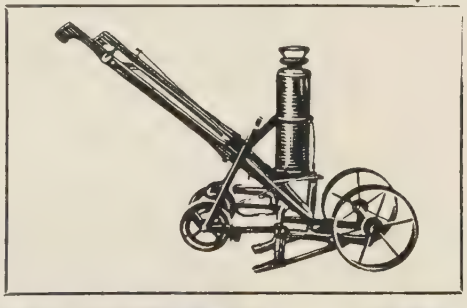

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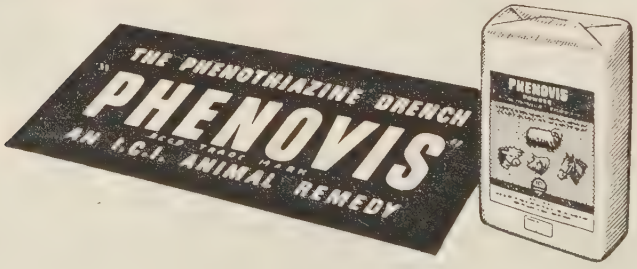

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The soil moisture fluctuations for the various frequencies of irrigation, together with the amount of evaporation (in inches) and rainfall (in points) between irrigations for the 1947-48 and 1948-49 seasons are given in Figures 1 and 2.

For the 1947-48 season, the soil moistures have been expressed as the ratio:

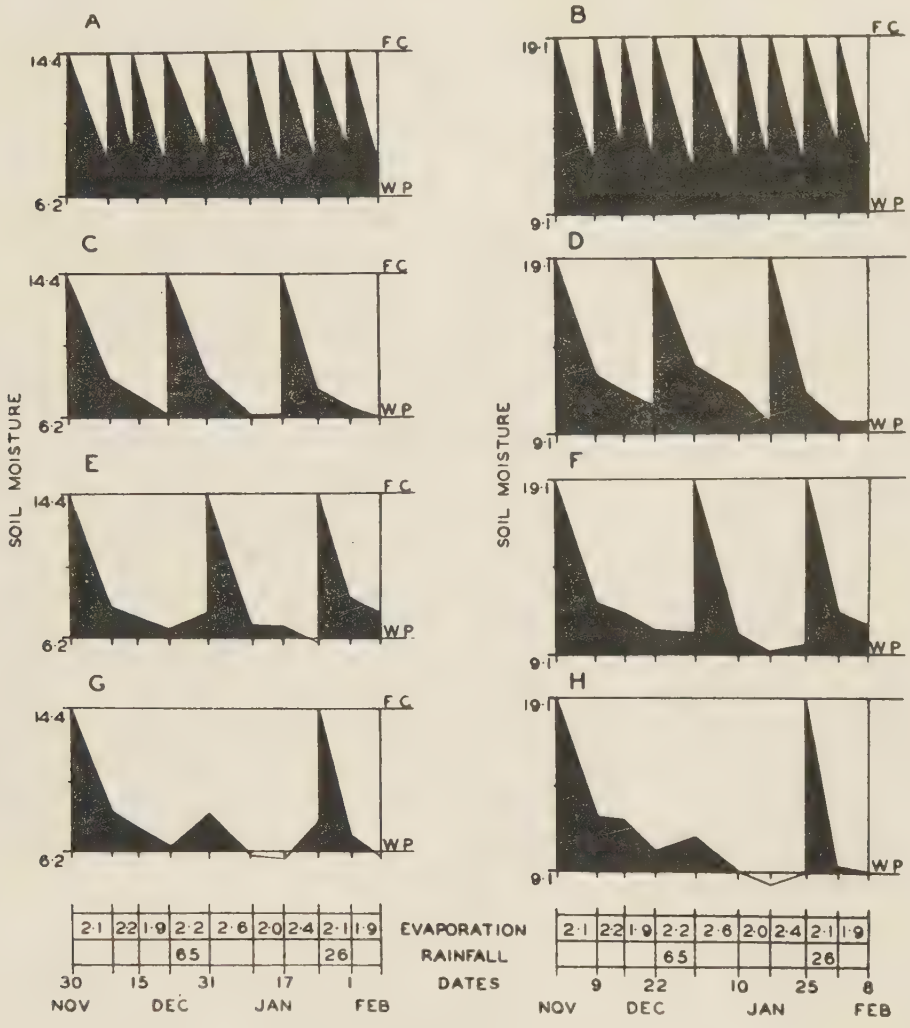

Figure 2

Soil Moisture Fluctuations at Various Dates at Depths of 3-9 and 9-18 inches for Four Irrigation Frequencies. 1948-49 Season.

FC: Field Capacity. WP: Wilting Point

A:	Irrigation	at	periods	of	approx.	2	inches	evaporation.	—	Depth:	3–9	in
B:	,,	,,	,,	,,	,,	2	,,	,,	—	,,	9–18	,,
C:	,,	,,	,,	,,	,,	6–7	,,	,,	—	,,	3–9	,,
D:	,,	,,	,,	,,	,,	6–7	,,	,,	—	,,	9–18	,,
E:	,,	,,	,,	,,	,,	7–8	,,	,,	—	,,	3–9	,,
F:	,,	,,	,,	,,	,,	7–8	,,	,,	—	,,	9–18	,,
G:	,,	,,	,,	when	plants	showed	signs	of wilting	—	,,	3–9	,,
H:	,,	,,	,,	,,	,,	,,	,,	,, ,,	—	,,	9–18	,,

soil moisture %/moisture equivalent. As the moisture equivalent figures at depths of 3-9 and 9-18 inches were not available, the soil moistures for the 1948-49 season have been expressed as moisture percentages of dry soil. Field capacity, wilting point and moisture equivalent were determined by methods described by Piper[2].

These graphs disclose that at depths of 16-18 and 9-18 inches, all the frequencies of irrigation with one exception—irrigation when plants showed signs of wilting—maintained sufficient soil moisture for plant requirements, and at no time did soil moisture losses reach wilting point. As was expected, soil moisture losses were greater at depths of 4-6 and 3-9 inches than at the deeper levels. Similar results were obtained in the 1945-46 season, although moisture levels were comparatively higher.

The rainfall (in points) recorded over the periods of the trials for the 1945-46, 1947-48 and 1948-49 seasons was 328, 41 and 91 respectively, and in some cases the effect of this was observed by the rise in soil moisture between irrigations.

The results indicate that in a normal season, after plants are established, irrigation at frequencies of 7-8 inches evaporation (approximately 28 days for the summer months of November, December, January and February) would be sufficient to maintain soil moisture at a satisfactory level for tomato plants in this particular soil type.

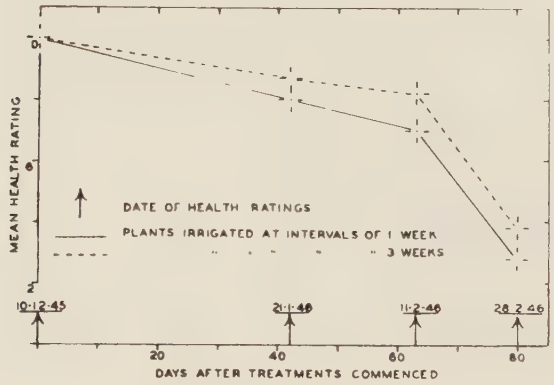

Figure 3.
Mean Health Ratings of Tomato Plants for Two Frequencies of Irrigation for the 1945-46 Season. Ratings Range from 10 for Healthy Vigorous Plants to 0 for Dead Plants.

Health of Plants

During the 1945-46 season, it was apparent that there were differences in the health and vigour of the plants between the two treatments and that there would be a reduced yield for plants irrigated at intervals of one week. At periods, therefore, throughout the season, health ratings were carried out on all plants in each of the 14 plots, using a rating scale from 10 to 0. The results of this survey are given in Figure 3.

It will be seen that the plants irrigated at intervals of three weeks were healthier than those irrigated at intervals of one week. As the more frequent irrigations may have been a factor in the incidence of Fusarium wilt, a disease common in the Mildura district, the plants were carefully examined for any evidence of this disease. It was found, however, that there was little difference between treatments, as 8 per cent. and 6 per cent. respectively of the plants irrigated at intervals of one week and of three weeks were affected. No other diseases were noted which could account for the difference and it was thought that the more frequent irrigations combined with heavy rain, produced a temporary waterlogging and subsequent lack of oxygen for the plants.

Yield of Plants

The mean yields of tomatoes for varying frequencies of irrigation for the three seasons are given in Table I.

The table shows that for the 1945-46 season, there was a significantly lower yield for plants irrigated at weekly intervals compared to those irrigated at intervals of three weeks. Although not quite significant, there was also a definite trend in this direction for the 1947-48 season. There were no significant yield differences for the 1948-49 season.

It is considered that the low yields of the plants irrigated at weekly intervals in

TABLE I

Yields of Tomato Plants for Varying Frequencies of Irrigation for the 1945-46, 1947-48 and 1948-49 Seasons.

Season	Irrigation Frequencies	Mean Yields lb./plant	
		Adelaide Dwarf Red	
1945-46	At intervals of 1 week	6.1	
	At intervals of 3 weeks	8.2	
		Pearson 29-17	Hybrid
1947-48	At intervals of 1 week	5.64	7.17
	At intervals of 3 weeks	8.04	9.38
	At intervals of 4 weeks	5.76	8.35
	At intervals of 5 weeks	7.34	8.33
1948-49	At periods of approx. 2 ins. evaporation		8.2
	At periods of approx. 6-7 ins. evaporation		8.0
	At periods of approx. 7-8 ins. evaporation		8.0
	when plants showed signs of wilting		7.0

Minimum difference for significance between treatment means at 1% level for 1945-46 season=1.85.
Minimum difference for significance between treatment means at 5% level for 1947-48 season=2.44.
Minimum difference for significance between treatment means at 5% level for 1948-49 season=1.70.

the 1945-46 and 1947-48 seasons were due to moisture excesses, particularly in the former season, when comparatively heavy rain was recorded.

In the 1948-49 season, with irrigation at intervals of approximately 2 inches evaporation, the moisture level was lower, and under these conditions, there was no adverse effect on yield.

Maturity

To ascertain any difference in the ripening of tomatoes for each treatment for each season, the mean maturity period was determined as follows:—The weight of fruit was recorded for each date of picking. For each picking date the weight of fruit in pounds was multiplied by the number of days from transplanting to picking. The products were added together and their sum divided by the total in pounds.

The difference in the mean maturity was less than 3 per cent. in any one year, indicating that the varying frequencies had no effect on maturation.

Root Growth and Distribution

In view of the difference in yield and health of the plants in the 1945-46 season, the roots of 21 plants from each treatment were examined after harvesting to determine any difference in root growth and root distribution. The following method was adopted:—Each plant was centred in a 24-inch square from which one quarter was sampled. Roots were cut with a sharp knife and separated from the soil by washing through a sieve. Total lengths (in 1/10 inches) and total dried weight (in grams) of roots at depths of 0-2, 2-5, 5-8 and 8-11 inches were recorded. These results are given in Table II. Although no measurements were taken, some roots were observed to penetrate to approximately three feet.

The change in mean length of root per section as depth increases is highly significant. The difference between treatments over all depths is not significant, but the trend in increasing length of roots with depth in the three-weekly interval relative to the weekly interval is significant at the 5 per cent. level. The results

TABLE II

Mean Lengths and Mean Weight of Roots for One Quarter Plant at Various Depths for Two Irrigation Frequencies.

Irrigation Frequencies	Mean Length of Roots (in 1/10 ins.)				
	Depths of				Combined
	0-2 in.	2-5 in.	5-8 in.	8-11 in.	Means
At intervals of 1 week	644.9	901.8	586.6	443.8	644.3
At intervals of 3 weeks	585.0	837.5	605.3	600.9	657.2
	Mean Weight of Roots (in grams)				
At intervals of 1 week	0.547	1.045	0.331	0.134	0.514
At intervals of 3 weeks	0.400	0.778	0.394	0.257	0.457

Lengths. Min. diff. for sig. between treatment sub-means at 5% = 14.9.
Lengths. Min. diff. for sig. between treatment sub-means at 1% = 20.5.
Weights. Min. diff. for sig. between treatment sub-means at 5% = 0.023.
Weights. Min. diff. for sig. between treatment sub-means at 1% = 0.038.

of analysis of weight parallels in all respects the analysis of length.

Conclusions

The results of the trials indicate that, after plants are well established, furrow irrigation (wetting the soil to field capacity to a depth of 3 feet to 4 feet) at periods of 7-8 inches evaporation is sufficient to maintain soil moisture at a satisfactory level for tomato plants grown on a Barmera Sand. For the summer months in a normal season in the Mildura district, it would take approximately 28 days before evaporation reached 7-8 inches. More frequent irrigation appears to be quite unnecessary.

The results also indicate that irrigation at weekly intervals, combined with comparatively heavy rain (328 points) during the 1945-46 season, had an adverse effect on both the health and yield of the plants. Although no significant yield differences were noted for the varying frequencies of irrigation in the 1947-48 season, the difference between waterings at intervals of one week and of three weeks, approached the 5 per cent. level of significance. This trend suggests that weekly irrigations adversely affect yields.

A possible explanation for the reduced yields is that the plants suffered from a temporary waterlogging resulting in lack of oxygen.

The varying frequencies of irrigation had no effect on the ripening of tomatoes in any of the trials.

No differences were noted in total root growth of plants to a depth of eleven inches but there were significant differences in root distribution. Frequent irrigations favoured a shallower root system.

Acknowledgments

The co-operation of the Mildura Shire Council in making the land available is gratefully acknowledged. Special thanks are due to several members of the staff of the Commonwealth Research Station, Merbein, who assisted in the work.

Messrs. G. McIntyre and R. Birtwhistle statistically analysed the data, and Mr. S. Bridley determined wilting points, field capacities and moisture equivalents.

References

1. Hubble, G. D. and Crocker, R. L. (1941).—"A Soil Survey at the Red Cliffs Irrigation District." C.S.I.R. Aust. Bull. No. 137.
2. Piper, C. S. (1942).—"Soil and Plant Analysis." (Hassell Press: Adelaide.)

(*Received for publication February* 24, 1950).

THE REDUCTION OF DROP OF WASHINGTON NAVEL ORANGES BY 2,4-DICHLORPHENOXYACETIC ACID

By H. J. FRITH

Introduction

In the Murrumbidgee Irrigation Areas the abscission of mature Washington navel oranges prior to harvest presents a problem. Recent work by Stewart and others[1,2,3] has shown that dilute solutions of 2,4-D are effective in reducing this drop in oranges and grapefruit.

At Griffith a pilot trial was conducted very late in the season in 1948 and gave promising results in reducing the drop of mature grapefruit. In 1949, two field experiments were conducted to investigate the effect of a range of concentrations of 2,4-D, applied at different times, in reducing the preharvest drop of mature Washington navel oranges. The object of these trials was to test the extent to which this method of reducing drop is applicable under the conditions of the Murrumbidgee Irrigation Areas.

Experiments

Trial I

Washington navel oranges were sprayed with 2,4-D solutions at the following concentrations:—0, 4, 16, and 64 parts per million 2,4-D. The treatments also included two times of spraying, namely, April 4, 1949, and June 28, 1949. At the April spraying, the fruit was green, immature and approximately two inches in diameter, while at the June spraying the fruit was mature. The experiment was of a randomized block design and the treatments were replicated three times. Each plot consisted of a single row of sixteen trees. The fruit remaining on the trees was harvested on August 16, 1949.

Trial II

Washington navel oranges were sprayed at the following concentrations:—0, 4, 12, and 36 parts per million 2,4-D. The 2,4-D was applied in two ways:—A water solution, and mixed with white oil and Bordeaux mixture. The sprays were applied during the first week of April, 1949, when the fruit was green and immature. The design was a randomized block experiment replicated three times and each plot consisted of four trees. The harvest began on August 22, 1949.

In each trial the spray solutions were made from the sodium salt of 2,4-dichlorphenoxyacetic acid in water prepared so as to contain the required concentration of 2,4-dichlorphenoxyacetic acid radicle.

Immediately after spraying, the fallen fruit under the trees was removed, and the fruit which dropped during the course of the trials was counted and removed at weekly intervals. At harvest the fruit remaining on the trees was counted. The fruit was harvested at the end of the commercial harvesting period for navel oranges.

Results

Effect on leaves

The earliest noticeable effect of the 2,4-D spray was a curling of the leaves of the trees. The 36 p.p.m. and 64 p.p.m. sprays caused buckling of mature leaves

H. J. FRITH, B.Sc. Agr. is a Research Officer of the Commonwealth Scientific and Industrial Research Organization and is at present at the Irrigation Research Station, Griffith, New South Wales.

and severe curling of young growth, whilst the 16 p.p.m. caused some curling of young growth only. The 12 p.p.m. and 4 p.p.m. sprays had no visible effect on the foliage. The effect of the 16 p.p.m. spray was temporary and disappeared within ten days as the leaves matured. However, the buckling of mature leaves caused by the 36 p.p.m. and 64 p.p.m. sprays was more persistent, although it disappeared after seven weeks.

Effect on fruit

The 36 p.p.m. and 64 p.p.m. sprays had an adverse effect on the quality of fruit that was young at the time of spraying. Fruit from these plots grew to an abnormal size and was characterized by very rough, thickened skin with a curious "pebbly" appearance. Many fruits were elongated and tended to become cylindrical in shape, and many developed seeds. Some typical fruits are shown in Figures 1 and 2. These abnormalities were similar to those described by Stewart and Klotz[1]. The lower concentrations had no visible effects on fruit quality and fruit that was mature at the time of spraying did not develop abnormalities at any concentration tested.

Figure 1

Figure 2

Showing the Abnormalities of the Skin of the Fruit caused by 64 p.p.m. 2,4-D. In each case the Upper Row of Fruit is Sprayed and the Lower Row Unsprayed.

Effect on fruit drop

In both trials, fruit began to drop during the week ending July 10, 1949.

Table I shows the number of mature fruits per tree that dropped during the experimental period in Trial I, expressed as percentage of the total fruit borne by the tree at the time of spraying.

TABLE I

Showing Percentage of Fruit per Tree Dropped in Trial I.

Concentration of 2,4-D in p.p.m.	Percentage of Crop Dropped	Percentage Reduction in Drop
0	44.5	—
4	33.1	27.5
16	26.6	40.2
64	22.5	49.4
Minimum significant difference P=.05	10.8	
P=.01	14.6	

The application of each concentration of 2,4-D spray caused significant reduction in the amount of fruit dropped, the effect being greater with the higher concentrations. These results are illustrated graphically in Figure 3. There was no difference in the effect of the sprays applied early and late. At the same concentrations the percentage of fruit dropped did not differ significantly, nor did the final total percentage of drop.

In Trial II the results were similar to those in Trial I; each concentration caused a significant reduction in the amount of fruit dropped. The inclusion

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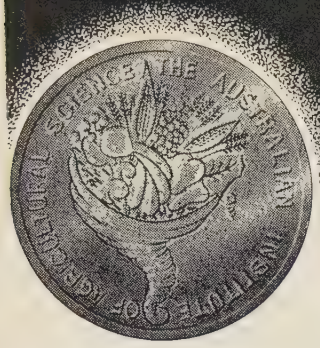

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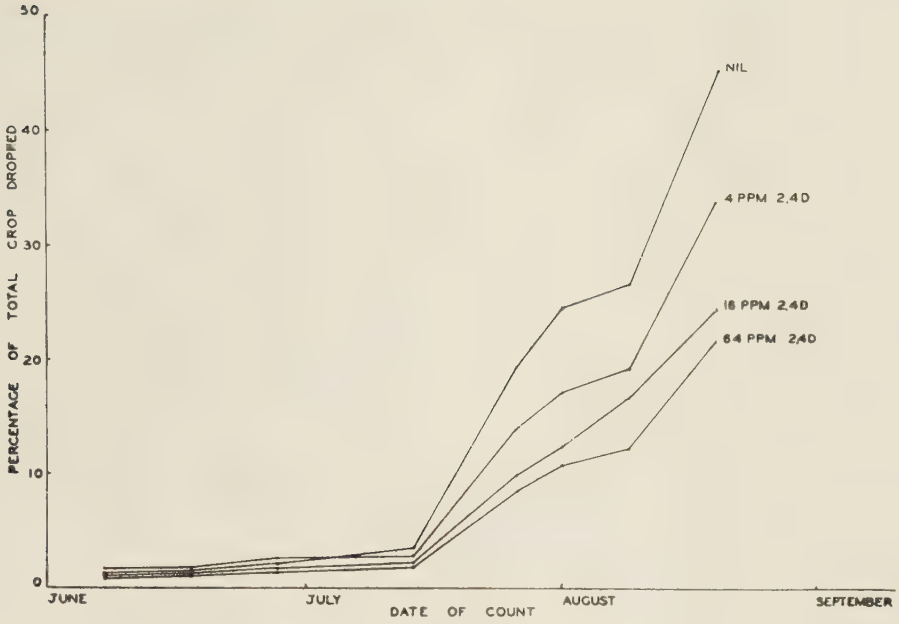

Figure 3

The reduction in Fruit Drop caused by the Concentrations of 2,4-D used in Trial I.

of the 2,4-D in the white oil-Bordeaux solution mixture did not cause any difference in the effect of the 2,4-D and the interaction of concentration with method of application was not significant. The results are shown in Table II and graphically in Figure 4.

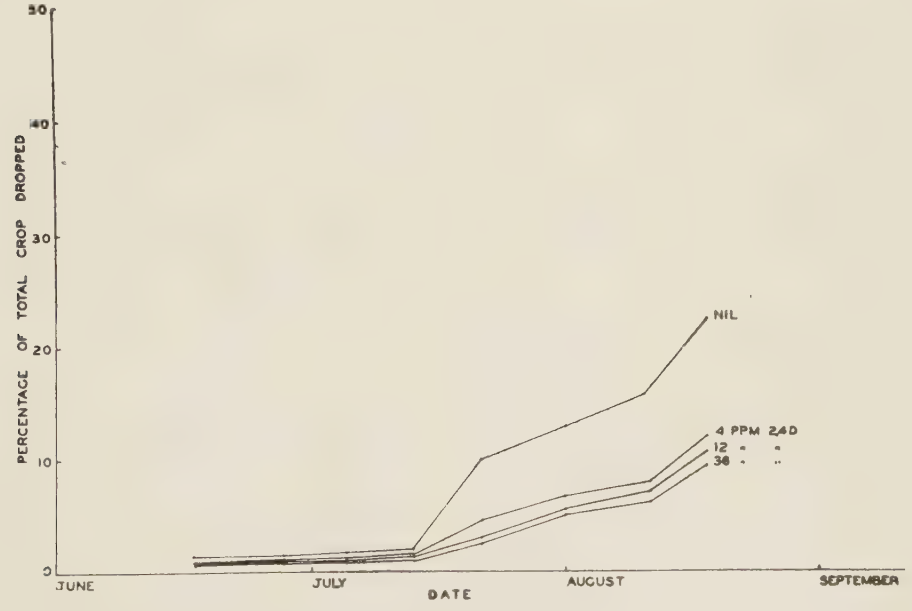

Figure 4

The reduction in Fruit Drop caused by the Concentrations of 2,4-D in Trial II.

TABLE II

Showing Percentage of Fruit per Tree Dropped in Trial II.

Concentration of 2,4-D in p.p.m.	Percentage of Crop Dropped	Percentage Reduction in Drop
0	22.5	—
4	17.0	24.0
12	15.2	32.4
36	12.0	42.0
Minimum significant difference P=.05	4.4	
P=.01	6.1	

Effect of concentration on drop

An inverse logarithmic relationship was found to exist between the concentration of 2,4-D and the percentage of drop of fruit. This is shown in Figure 5.* This relationship can be expressed as follows:—

$$y = 0.3 \log 1260/x$$

where y = ratio of fruit drop with spray to fruit drop without spray,

x = concentration of 2,4-D in p.p.m.

The following equation has been calculated for the data of Stewart, Klotz and Heild[3]:—

$$y = 0.3 \log 132/x$$

It is to be seen that the coefficient is the same but the constant has changed for the different set of conditions.

Conclusions

The results obtained by Stewart and Klotz in California are confirmed for the conditions on the Murrumbidgee Irrigation Areas.

Dilute solutions of 2,4-dichlorphenoxyacetic acid are effective in reducing the preharvest drop of mature Washington navel oranges.

The reduction in the amount of fruit drop varies with the concentration of the spray applied but the higher concentrations have increasingly less effect.

Concentrations of up to 16 p.p.m. 2,4-D had no obvious effect on the quality of the fruit but at concentrations of 36 and 64 p.p.m. 2,4-D abnormalities appeared in the fruit. As damage may be done to the trees, until further experience accumulates, care should be exercised in the use of 2,4-D for the purpose of reducing fruit drop.

The spray is effective when applied at the beginning of April to reduce drop in the following July and August, but if applied only two weeks before the beginning of fruit drop it is just as efficient in reducing this drop.

The inclusion of the 2,4-D in the white-oil-Bordeaux solution mixture applied for red scale and black spot control does not alter its efficiency in preventing fruit drop.

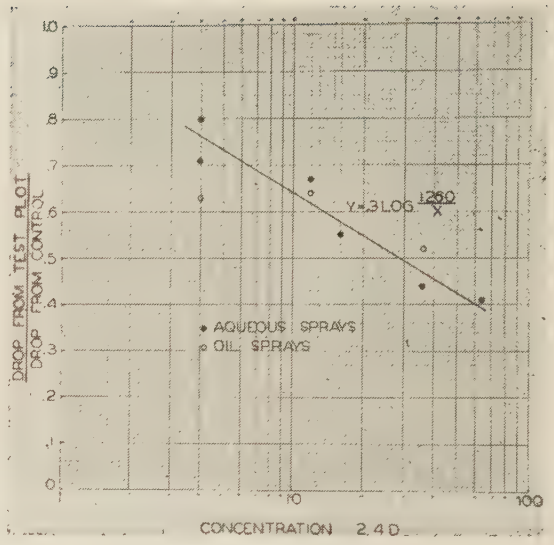

Figure 5

Relation between Ratio of Fruit Drop with Spray to Fruit Drop without Spray and Concentration of 2,4-D in p.p.m.

*In Figure 5 the drop from trees sprayed with 2,4-D mixed with white oil is shown as circles, but these values are omitted from the regression as they are not strictly comparable to the aqueous sprays.

References

1. Stewart, W. S. and Klotz, L. J. (1947).—Some effects of 2,4-D on fruit drop and morphology of oranges. *Bot. Gaz.* **109**: 150-162.
2. Stewart, W. S. and Parker, E. R. (1947). Preliminary studies on the effects of 2,4-D sprays on preharvest drop yield and quality of grapefruit. *Proc. Am. Soc. Hort. Sci.* **50**: 187-194.
3. Stewart, W. S. & Klotz, L. J. and Heild, H. Z. (1947). — 2,4-D sprays for control of navel orange drop. *California Citrograph.* **33**: 49.

(*Received for publication February* 16, 1950.)

TECHNICAL NOTES

AN OUTBREAK OF OXYCANUS FUSCOMACULATUS WALKER ON KING ISLAND

Oxycanus fuscomaculatus Walker (Lepidoptera Fam. Hepialidae) is one of the numerous insects which are referred to as grass grubs. So far as is known it is not normally a major pest of pastures in Tasmania, although Tindale[2] holds the view that "Part at least of the damage [to pastures] attributed to *Oncopera* is done by *Oxycanus fuscomaculatus*."

This report deals with an outbreak of *Oxycanus fuscomaculatus* in pastures on King Island during the winter of 1949, where, on two properties alone, 250 acres of grassland were completely denuded by the ravages of this pest. Much of the damage was in patches 15 to 20 acres in extent, the balance being in smaller patches.

Description of the Insect

The male moth is about an inch in length with a wing span of two inches. The fore-wings have a distinctive pattern consisting of rows of irregular greyish markings. The female moth is one and a quarter inches in length and three inches across the wings. The markings on the fore-wings are somewhat fuscous and less distinct than in the male. (*Fig. 1.*) The full-grown larva and the pupa are shown in *Fig. 2.* The former measures up to three inches in length and has a dark brown head capsule. The thoracic plates are a pale brown and the abdomen is bluish-grey on the dorsal surface and pale green ventrally. On the penultimate abdominal segment the bases of the main setae are surrounded by clear areas. The pupa is brown and is one and a quarter to one and a half inches long. It is typically hepialid in appearance.

Distribution in Tasmania

Tindale[2] recorded *Oxycanus fuscomaculatus* from Lefroy, Sandford, Launceston and Piper's River in Tasmania. Moth specimens in the collection of the Department of Agriculture were taken at Parattah, in the Midlands, on 7.v.36 and at King Island on 26.v.42.

In the files of the Department of Agriculture, Evans had an entry on 8.vii.41 of last instar hepialid larvae being forwarded from King Island from a heavily infested paddock. He provisionally identified the larvae as *Oncopera rufobrunnea* Tindale, but an examination of the tubed specimens in the departmental collection showed that this was a misidentification and the species involved was *Oxycanus fuscomaculatus.* So far as is known, this was the first record of economic damage having been caused by this species in Tasmania, but the true identity of the pest was not realised at the time.

Ecology

The observations that are recorded in this report are limited in scope, due to the fact that the author was able to make only one trip to King Island early in August, 1949, to see the damage that was being caused by *Oxycanus fuscomaculatus.* Following that date further specimens of larvae, pupae and moths were forwarded from King Island from time to time so that some idea on the life cycle could be obtained.

Figure 1.
Oxycanus fuscomaculatus Walker, King Island, 6.v.50. Above, male; below, female.

This outbreak of *Oxycanus fuscomaculatus* on King Island was confined to the calcareous and semi-calcareous sand areas that form much of the good grazing land on the west coast of the island. Stephens and Hosking[1] defined these soil types as the Currie Calcareous Sand, and the Yambacoona Sand respectively. The Currie Calcareous and Yambacoona Sands are absent from the east coast of the island except for one small pocket of the former which is overlaid in some places by Naracoopa Sands. In the normal phase the Naracoopa Sand is acid in reaction with an organic hardpan, but where it overlies Currie Calcareous Sand it is alkaline with no marked hardpan formation. Some underground grass grubs were present in this pocket on the east coast but no evidence of severe damage was seen. None of the other soil types carried populations of the grubs. On one affected property it was mainly hillsides with southerly aspects that were attacked and from the crests of these hills the lines of demarkation were readily seen. As this was not observed elsewhere it may be of no significance.

In August, 1949, when the visit to King Island was made, the grubs were fully grown. There was no sign of any younger larvae so that the damage was apparently being caused by a single generation of grubs. The areas that had been denuded were on unimproved pasture in which *Bromus gussonii* was the main species present. Areas of improved pastures consisting mainly of perennial ryegrass and subterranean clover did not appear to be as severely affected. The grubs had also killed out clumps of tussock grass (*Poa sp.*) by feeding on the roots. The stems of the tussocks were not eaten, evidently being unpalatable, but around the roots a concentration of the larvae was found, while horizontal galleries typical of root feeding insects were seen. Evidence of feeding on dung pads was also found, holes right through the pads being seen quite readily. In a few cases, larvae were found on the surface of the ground under dung pads.

Some larvae were obviously suffering from starvation, because many were quite sluggish and some were very nearly dead from the lack of food. Not much migration could have been occurring as the grub population was not high on areas where there was ample growth even though this plentiful food supply adjoined patches which were badly eaten out. It is possible that both the root feeding and

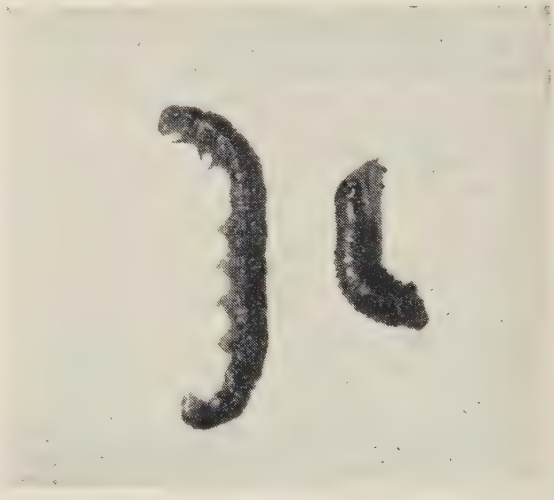

Figure 2.
Oxycanus fuscomaculatus Walker, King Island. Full grown larva and pupa.

the occurrence of grubs above ground under dung pads may have been a typical behaviour caused by starvation.

The following observations were made by the District Agricultural Officer stationed on King Island or determined from material forwarded by him. There was no sign of pupation in January, 1950, but pupae were found on 16.iii.50. The moth flights began on 21.iv.50 and reached a peak on 6.v.50 after a fall of twenty-five points of rain. The flights occurred at night and continued after it was quite dark.

Acknowledgments

The author wishes to acknowledge the co-operation of Mr. Snodgrass and Mr. Tetham, on whose properties most of the observations were made. Mr. V. J. Fagan, District Agricultural Officer, King Island, helped considerably by forwarding records of his observations and also larval and adult specimens. Mr. W. K. Burgess, Assistant District Agricultural Officer, King Island, identified the pasture plants from the infested area. Mr. N. B. Tindale, of the South Australian Museum, kindly identified moth specimens. Thanks are also due to Mr. L. W. Miller, Chief Entomologist, for his helpful criticisms of this manuscript.

References

1. Stevens C. G. and Hosking, J. S., (1932). A Soil Survey of King Island, C.S.I.R. (Aust.) Bull. No. 70.
2. Tindale, N. B. (1935). Revision of the Australian Ghost Moths (*Lepidoptera Homoneura* Family Hepialidae) Part III. Rec. S. Aust. Mus. 3: 282, 294-6.

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Horticulturists familiar with Professor Chandler's "Fruitgrowing" and "Deciduous Orchards" will be in no way disappointed with "Evergreen Orchards." It is an equally good book. Perhaps it is even more valuable than its predecessors, for while many good general books on deciduous fruit trees and their culture have been written, comparable texts on evergreens are few. It is for this reason that horticultural workers in temperate regions so often fail to recognize that interesting and important differences in tree response exist between evergreens and deciduous trees. The former are, unfortunately, often handled on the basis of experience with the latter. Evergreen Orchards should help to repair the deficiency.

The book is written for undergraduate teaching; but makes excellent post-graduate reading with a valuable bibliography for each chapter. It does not attempt to discuss orchard and fruit handling practices as such; but, for the most part, the underlying principles which assist in understanding tree behaviour and solving the more difficult orchard problems.

FRANK M. READ.

AN INDICATOR OUTFIT FOR SOIL REACTION TESTS IN THE FIELD

The rapid determination of soil reaction depends upon either a colorimetric or an electrometric method. For soil survey investigations in the field the colorimetric method is to be preferred because of its compactness and ease of manipulation.

In the colorimetric method the colour imparted by the soil to an indicator is compared with a standard colour chart. Because of the colour of the soil and the turbidity of the suspension recognition of this colour is not always easy. As previous workers have shown, the comparison may be carried out independently of the colour of the soil and against a white background by sprinkling barium sulphate powder upon the soil-indicator paste. The indicator, and hence its colour, is taken up by the barium sulphate particles. In this way the pH of the soil in the paste condition may be ascertained to the nearest 0.5 unit. The commercial outfits used by soil surveyors in the United States and elsewhere overseas contain a bottle fitted with a dropping pipette for the indicator, a bottle having a perforated cap for the barium sulphate powder, and a white spot-tile for mixing the indicator and soil. The colour produced is compared with that on a colour card supplied. Because of the rapidity with which tests can be carried out in the field, soil surveyors are finding such outfits of considerable value.

An indicator suitable for use in this way may be made up as follows: Add 0.1g. each of bromo cresol green, bromo cresol purple, bromo thymol blue and m-cresol purple to 75 ml distilled water and allow the mixture to stand overnight. If the indicators have not all dissolved next morning very slight warming may be used. Then add 0.1N sodium hydroxide, drop by drop, to adjust the pH of the mixture to 7.0, using the glass electrode to determine the end point. The indicator is now ready for use.

To determine the reaction of a soil place a small amount of the soil on a spot tile, add a few drops of indicator and make the mixture into a paste. Experience will indicate the proper amount of indicator to use. Immediately after making the paste sprinkle it with barium sulphate powder and note the colour produced. The colours produced range from yellow at pH 4 through green to dark blue at pH 8.5-9.0. Standards or colour patches may be easily distinguished in steps of 0.5 units.

M. RAUPACH.

Division of Soils,
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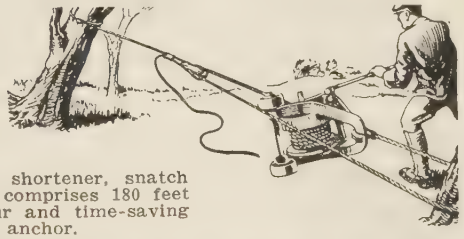

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CHEMICALS FOR THE CONTROL OF WEEDS AND NEMATODES IN TOBACCO SEED-BEDS

In North Queensland, tobacco seed-bed sites are sterilized by burning a layer of the inner matrix of termite mounds on the surface of the prepared soil. The supply of this material is limited and alternative methods of sterilization require investigation. In a test at Clare during 1949, eight treatments, each repeated four times, were established on a fine sandy loam soil in randomised plots each 9 sq. ft. in area and separated from other plots by a distance of three feet. Prior to treatment, all plots were inoculated with nematode infested material buried to a depth of six inches.

Observations made fifty-two days after sowing, when the seedlings in the seed-beds treated with termite material were of transplanting size, were analyzed statistically, and are summarized as follows:—

Treatment	Mean No. of Weeds per Plot*	Mean Wt. of 32 representative seedlings from each plot in g.	Mean % Nematode Infection
No treatment	38	2.3	42.6
"Cyanamid" ½ lb./sq. yd. Urea 1 lb./sq. yd.	0	26.2	0
"Cyanamid" 1 lb./sq. yd. Urea 2 lb./sq. yd.	0	10.5	0
"Cyanamid" 1 lb./sq. yd.	5	34.0	6.7
"Cyanamid" 1½ lb./sq. yd.	2	29.3	2.9
Termite Material	2	60.3	0
DD. 48cc./sq. yd.	107	28.1	0
DD. 64cc./sq. yd.	52	30.3	0

*Exclusive of a border three inches wide.

"Cyanamid" is a trade name for calcium cyanamide and was supplied as pellets which were thoroughly mixed with the top three inches of soil seventy-three days before sowing. Urea was mixed with the "Cyanamid" immediately before use. D.D. (dichloropropane-dichloropropylene) was poured into holes six inches deep and spaced nine inches apart, which were then sealed and seed sown eleven days later.

Good control of weeds and nematodes and rapid growth of seedlings was obtained when termite material was used. "Cyanamid"-urea mixtures controlled both weeds and nematodes but seedling growth was reduced at the higher rate of application. "Cyanamid" alone reduced weed growth and nematode infestation. D.D. effectively controlled nematodes but apparently stimulated weed growth. The effect of nitrogen in "Cyanamid" and urea was evident in the dark-green colour of the seedlings.

T. G. HANEY.
Division of Plant Industry,
C.S.I.R.O.,
Brisbane, Queensland.

(*Received for publication, July* 18, 1950.)

COUNCIL PROCEEDINGS

June Meeting

The 108th meeting of Council was held at C.S.I.R.O., Canberra, on Monday, June 5, 1950.

Present

Dr. T. H. Harrison (in Chair); Mr. C. H. Williams (S.A.); Mr. C. G. Greenham (Q'ld.); Mr. C. M. Donald (N.S.W.); Mr. R. D. Brock (A.C.T.); Dr. C. Barnard (Tas.); Mr. F. O. Grogan (W.A.); Mr. A. V. Hill (Hon. General Treasurer); Mr. G. A. McIntyre (Hon. General Secretary).

Salaries and Status

A draft letter and questionnaire on salary and status was received from the Melbourne University Appointments Board which is conducting a survey of the Agricultural Profession.

It was resolved "That Branches of the Institute be requested to encourage the fullest cooperation of their members in completing and returning promptly the questionnaire forwarded by the Melbourne University Appointments' Board."

Rural Extension Services

An interim report on extension services was presented by members of the Sub-Committee, Messrs. Donald and Grogan. Council considered the statement and decided to accept its recommendations as essential to the preparation of the final report.

Agricultural Engineering

Council considered the comments of Branches on the report on Agricultural Engineering prepared by a Sub-Committee of Council. This report has aroused considerable interest and alternative courses of action have been recommended.

After some discussion it was resolved —"That Council has noted that in Victoria a Sub-Committee with special qualifications in engineering has been formed to consider further developments arising out of the report on Agricultural Engineering. Because of the particular qualifications of the Victorian Committee, Council resolves that this Sub-Committee be requested to act as a sub-committee of Council to review the original report in the light of comments received from various States and to present a revised report to Council in the near future."

Interchange of Personnel

It was resolved that the letter on interchange of personnel be forwarded in the name of the Institute to the Prime Minister and Premiers and that the Joint Standing Committee be advised of this intention.

Free Journal Reprints

Following comments received from Branches and a statement from the Honorary Business Manager of the Journal Mr. J. S. Orr it was resolved—"That up to fifty reprints will be supplied free of charge to authors of signed articles published in the Journal. Authors will be required to fill in an order slip for the number of free reprints wanted up to this limit and any additional number desired. The rate for the extra copies will be established on the basis existing at present for a single order equal to the number of extra copies."

The attention of the meeting was drawn to a resolution from the Publications Committee about expenditure on free reprints namely—"That before any expenses are incurred in providing free reprints to Authors, Council should give consideration to the payment of honoraria to the officers concerned with the publication of the Journal."

Membership

ADMISSIONS.

The following applicants were approved for **Corporate Membership:—**

Ballard, J. H.	N.S.W.	Byrnes A. W.	Victoria
Beattie, J. A.	„	Beckwith, R. S.	„
Cameron, D. G.	„	Curnow, N. A.	„
Colwell J. D.	„	Dooley, M. H.	„
Durham, L. J.	„	Holloway, B. W.	„
Feilen, P. G.	„	Lemaire, P. L.	„
Jenkins, H. V.	„	Maclean, T. N.	„
McGarity, J. W.	„	Mason, M. J.	„
Murty, D. W. P.	„	Symon, D. E.	„
Reilly, D.	„	Crowley, N. C.	S. Aust.
Simpson, R. I.	„	Kleinig, C. R.	„
Wingrave E. G. (Miss)	„	Nankivell, W. F.	„
		Ryan, J. W.	„
		Shukla, P. K.	„

The following applicants were admitted to **Student Membership:—**

Adamson, D. A.	N.S.W	Lee, G. R.	„
Barr, D. A.	„	Little, I. P.	„
Barrie, J. W.	„	Marshall, K. C.	„
Begg, J. E.	„	McFarlane, J. D.	„
Begley, L. G.	„	Mills, W. C.	„
Bockman, D.	„	Monaghan, J. T.	„
Brady, C. J.	„	Morse, B. V.	„
Carter, O. G.	„	Munro, D. N.	„
Carlton, M. A.	„	Newman, J. C.	„
Charles, A. E.	„	Philpotts, H. (Miss)	„
Dann, P. R	„	Reis, P. J.	„
Davern, C. I.	„	Ridge, R. H.	„
Davey, B. G.	„	Robertson, F. R. (Miss)	N.S.W.
Donald, N. O.	„	Saunders, J. C.	„
Donovan K. O. (Miss)	„	Seeman, E. E. (Miss)	„
Dotch E. R. (Miss)	„	Stannard, M. C.	„
Fisher, J. M.	„	Weir, R. G.	„
Goodchild, D. J.	„	Woodhouse, L. R.	„
Gregory, G. R.	„	Wright, P.	„
Griffith, C.T. De B.	„	Young, D. J. B. (Miss)	„
Hall, B. J	„	Oram, R. N.	S. Aust.
Harland, C. W. E.	„	Davidson, J. L.	„
Haskew, H. C.	„	Tideman, A. F.	„
Horden, R. M.	„		
Lawler, T. R.	„		

Institute Scholarships

The question of Institute Scholarships was raised by the South Australian Branch. It was resolved—"That Council notes with interest the suggestion from the S.A. Branch that an attempt be made to initiate a scheme for Institute Scholarships along the lines of the existing scheme in Canada. Details of this scheme will be referred to Branches for consideration."

August Meeting

The 109th meeting of Council was held at C.S.I.R.O., Canberra, on Tuesday, August 15, 1950.

Present

Mr. F. W. Hicks (in Chair); Mr. E. M. Hutton (S.A.); Mr. C. G. Greenham (Q'ld.); Mr. C. M. Donald (N.S.W.); Mr. R. D. Brock (A.C.T.); Dr. C. Barnard (Tas.); Mr. F. O. Grogan (W.A.); Dr. I. Molnar (Vic.); Mr. A. V. Hill (Hon. General Treasurer); Mr. G. A. McIntyre (Hon. General Secretary).

Advice has been received that Dr. I. Molnar has been appointed Proxy delegate for Victoria and Mr. E. M. Hutton alternative Proxy delegate for South Australia.

Delegates Expenses, Honoraria

The meeting discussed at length the financial position as revealed in the Treasurer's Report and the question of honoraria, salaried officers and delegates expenses.

On the question of honoraria and paid officials Victoria favours the payment of substantial honoraria; A.C.T. is opposed to the idea of a paid Secretary and favours increased honoraria; W.A., considers the time is ripe for a permanent Secretary; and N.S.W. is opposed to the practice of granting honoraria. It was generally agreed that the whole question of policy on the structure of Council's executive would have to be decided at a General Meeting.

The following motions were carried:—

"That the present scale of honoraria to honorary officers of Council adopted at 103rd Meeting of Council be retained."

"That the whole question of organisation and payment of the Council's officers be placed on the Agenda for

the General Meeting to be held in Brisbane."

"Each case concerning the expenses of a delegate should be determined on its merits by Council and the Branch involved, as long as Council meets the delegate's expenses wholly or in part."

Institute Scholarships

It was resolved—"That a sub-committee of Council be appointed to examine the South Australian proposals further and to determine in particular the need for assistance to suitable students for post-graduate studies."

"That the members of this committee be Messrs. R. D. Brock, C. H. Williams and G. A. McIntyre with power to co-opt."

Editorship of A.I.A.S. Journal

It was reported that advice had been received from the Publications Committee that the resignations of Joint Editors, A. J. McIntyre, and A. Shavitsky were accepted with regret at a meeting on 19.vi.50. At this meeting the Committee resolved to recommend to Council that Mr. N. M. Tulloh be appointed Editor of the Journal as from July, 1. These recommendations were adopted by Council.

Membership.

ADMISSIONS

The following applicants were approved for **Corporate Membership:—**

R. A. Bettenay	W.A.	K. W. Finlay	W.A.
E. W. Boehm	„	D. J. Fleay	„
Mrs. V. H. Camerer	„	D. K. Giles	„
R. F. Doepel	„	R. C. Gorman	„
P. W. R. Travers Drape	„	Miss O. M. Goss	„
J. P. Fallon	„	S. E. Hardisty	„
		K. M. Hope	„
A. W. Humphries	W.A	Miss L. J. Bancroft	N.S.W.
B. A'B Marsh	„	A. B. Costin	„
T. E. McDowell	„	E. H. Jacob	„
N. McNeil	„	D. Moyes	„
G. H. Neil	„	Miss H. Purchase	„
M. C. Nottle	„	Miss J. A. Stubbs	„
J. A. Parish	„	Miss R. P. Bertie	Q'ld.
B. J. Quinlivan	„	Miss L. J. Brimblecombe	„
J. T. Reeves	„	Miss S. Cossins	„
D. G. Shedley	„	K. J. Hutchinson	„
Miss R. J. Smyth	„	J. E. Ladewig	„
G. W. Spencer	„	Miss M. D. Penny	„
J. E. Watson	„		
V. J. Williams	„		

The following applicants were admitted to **Student Membership:—**

J. R. Adamson	W.A.	D. J. McRae	W.A.
Miss C. A. Belford	„	L. F. Metcalfe	„
Miss J. Campbell	„	P. G. Ozanne	„
B. F. Carlin	„	Miss C. N. Padgham	„
K. S. Cole	„	G. A. Pearce	„
R. G. Coleman	„	G. R. Pearce	„
E. J. S. Cook	„	R. A. Pearce	„
S. A. Debeaux	„	T. Poutsma	„
D. P. Fischer	„	L. W. Pym	„
E. N. Fitzpatrick	„	J. H. Silsbury	„
J. L. Frith	„	J. A. C. Smith	„
D. J. Fry	„	M. Somers	„
L. J. Gaffney	„	T. C. Stoneman	„
J. C. Grasby	„	I. K. Stott	„
C. R. Hale	„	H. Suejdendorp	„
M. G. Hawson	„	J. B. Truscott	„
A. F. Hehir	„	J. R. M. Wolfe	„
A. W. F. Hobbs	„	D. R. Wolff	„
D. A. W. Johnston	„	R. G. Woodward	„
J. A. Lawson	„	J. S. Yates	„
I. P. Barrett-Lennard	„	G. D. Kohn	Vic.
A. J. E. Lyneham	„	M. W. McDonald	N.S.W.
P. P. Mann	„		

RESIGNATIONS

The following resignations were accepted with regret:—

Mr. G. N. Lowe	W.A.
Dr. R. L. Crocker	S.A.

TRANSFERS

Mr. W I. Nankivell—Queensland to Victoria.
Mr. D. D. Shaw —Victoria to A.C.T.
Mr. A. Howard —N.S.W. to Queensland.

BRANCH NOTES

Australian Commonwealth Territory

A general meeting of the Branch was held on April 24, 1950, when the United States Agricultural Attaché, Mr. T. C. M. Robinson, delivered an address entitled "Agricultural Statistics and Field Services in the United States." Mr. Robinson was formally Senior Officer in the Bureau of Statistics of the United States Department of Commerce.

A general meeting of the Branch was held on July 5, 1950. Dr. Viljoen, High Commissioner for the Union of South Africa in Australia, delivered an address on "Agriculture in South Africa." The address was followed by two films—"Vanishing Africa," a film on soil erosion and "An Interlude in South Africa," a film on the Kruger National Park. Dr. Viljoen was formerly Professor of Veterinary Science at the University of Pretoria, Deputy Director of Veterinary Services and Secretary for Agriculture and Forestry in the Union of South Africa.

New South Wales

At a general meeting of the branch held on April 28, Prof. J. R. A. McMillan, Dean of the Faculty of Agriculture at the University of Sydney, spoke on the work of the Food and Agricultural Organisation Conferences which he recently attended as Australian delegate. He also discussed certain aspects of agricultural research and extension in the United States and Canada.

F.A.O. has the broad objective of increasing the production and nutritive value of foodstuffs and promoting food distribution within and between countries. Help is given to countries mainly through advisory work and demonstrations. Problems of over production in one country and under production in another are being studied.

The four main regions of activity are Europe, the Near East, the Far East and Latin America. The headquarters are at present in Washington but the permanent location in the future will be in Italy.

During his visit to the United States the speaker was particularly interested in types of glasshouses for plant culture work. He described an elaborate Plant Environment Regulator at the California Institute of Technology and a number of other types of chambers which were proving successful. He suggested that the use of such equipment may limit the use of glasshouses in the future.

Queensland

At the Annual General Meeting of the Queensland Branch on March 22, the retiring President, Mr. C. W. Winders, delivered his Presidential address entitled "The Written Word and its Influence on Agricultural Education."

Mr. W. E. Armstrong, Manager of the Commonwealth Flour Mills, addressed the May meeting on "The Flour Milling Industry in Queensland," pointing out the problems associated with milling in that State.

Dr. Oliver West, Senior Pasture Research Officer, Department of Agriculture, Southern Rhodesia, addressed the June meeting in connection with "Pasture Problems in Southern Rhodesia."

South Australia

A General Meeting held on July 14, 1950, took the form of a discussion on "The Requirements of a Modern Agricultural Scientist," with special reference to the adequacy of existing University courses in Science and Agricultural Science in meeting these requirements.

A sub-committee was elected to prepare a report on the proceedings for submission to the Branch Committee.

Tasmania

Included in the winter programme of Branch meetings was an evening organised in co-operation with the Chemical Institute and held in the Pathology wing of the Royal Hobart Hospital. Members of both organisations were shown something of the work of the Plant Pathology and Entomology Divisions of the Department of Agriculture and the laboratories of the Public Health Department.

Exhibits dealt mainly with current activities—research work on red spider and grass grubs in the Entomology section, and deficiency problems and virus on potatoes and strawberries in the Plant Pathology section. The Public Health Department exhibits covered the vitamin contents of foods, classification of breads, chemical analysis of soils and other projects.

Victoria

The Melbourne University Agricultural Society held a meeting on July 7 when Dr. A. Watt, of Cambridge, spoke on "The Ecology of Bracken."

On August 4, the Society held its Annual At Home which took the form of a dinner at Union House, followed by a presentation of two plays by the Tin Alley Players.

The Victorian Branch held a meeting on August 11, when Dr. I. F. Phipps, Biological Research Manager of I.C.I.A.N.Z., gave an address on Recent Developments in Pest and Disease Control.

At Melbourne University on August 3, Mr. A. E. O'Brien was presented with a wallet of notes on the occasion of his retirement from the position of Secretary of the School of Agriculture. Mr. O'Brien joined the staff of the University in 1902, and during his term at the School of Agriculture won the high regard of members of the staff, graduates and undergraduates. The function was attended by many of his friends and former associates and included Sir John Medley and the former Registrar, Mr. J. P. Bainbridge. Three films were shown, after which Professor and Mrs. S. M. Wadham entertained the gathering at supper in Union House.

Western Australia

An Ordinary General Meeting of the W.A. Branch was held on May 26, when Mr. A. M. Stewart, Assistant Director of the Institute of Agriculture, presented a comprehensive address entitled—"Range Research in the U.S.A."

Mr. Stewart recently returned from America where he travelled extensively through the western states, visiting research stations and farms.

The areas dealt with were the Pacific Coast region of California and Oregon, and the inter-mountain region between the Cascade and Sierra Nevada Ranges and the Rocky Mountains.

Much interesting information about the vegetation and carrying capacity of the country, and the regeneration of overgrazed areas was presented by the speaker, and conclusions were drawn that were applicable to land use in Australia.

At the Ordinary General Meeting of the W. A. Branch, held on June 23, members were addressed by Mr. W. J. Russell, Honorary Treasurer of the Farmers' Union. The speaker, who recently travelled through the north-eastern and mid-western states of America, outlined a farmers' impressions of Agricultural extension work and education in the U.S.A.

MR. F. W. HICKS — PRESIDENT FOR 1950

Mr. Hicks attended the Hawkesbury Agricultural College and gained his diploma in 1921.

He joined the New South Wales Department of Agriculture first as an Experimentalist and later held the position of Instructor in Agriculture in the Department of Public Instruction.

In 1926 he joined the Tasmanian Department of Agriculture as a District Agricultural Officer and was appointed Agricultural Superintendent in 1936. In 1947 he became Superintendent of Extension and Technical Services in the Department of Agriculture. This position involves the direction and co-ordination of research and extension activities including the teaching of agricultural education in area schools.

Mr. Hicks is a member of the Standing Committee of Agriculture and was Chairman of the Committee in 1940 and 1946, a member of the Agricultural Bank Board of Tasmania from 1937 to 1949 and a member of the Closer and Soldier Settlement Board of Tasmania from 1937 to 1949. He is at present a member of the Australian Committee on Animal Production and its Technical Sub-Committees on Fat Lamb Production and on Pig Production. He is also a member of the Tasmanian Post-War Land Development

Committee, a member of the State Economic Planning Executive, a member of the State Committee of C.S.I.R.O., and Tasmanian Representative on the inter-Departmental Committee on Meat Production Development.

PERSONAL

Australian Commonwealth Territory

Mr. A. J. Anderson, of the Division of Plant Industry, Commonwealth Scientific and Industrial Research Organization, left Australia in July for twelve months' study leave in England, the United States and Canada.

Mr. T. Strong has been appointed Acting Director of the Bureau of Agricultural Economics.

Mr. A. Shavitsky, formerly Research Secretary of the University of Melbourne, has been appointed Technical Secretary to the Division of Plant Industry, Commonwealth Scientific and Industrial Research Organization.

New South Wales

Mr. A. B. Costin has been awarded a Pawlett Scholarship and will carry out research on methods of soil conservation at the University of Sydney.

Mr. F. C. Butler, of the New South Wales Department of Agriculture, will shortly leave for Cambridge to continue research in plant pathology as the holder of a Walter and Eliza Hall Fellowship.

Mr. F. W. Hely, Research Officer of the Division of Plant Industry, C.S.I.R.O., has been awarded a Farrer Research Scholarship.

Dr. D. B. Duncan recently resigned from the staff of the Faculty of Agriculture, University of Sydney, and is about to take up the position of Associate Professor in Statistical Method at the Virginia Polytechnic Institute.

Dr. E. G. Hallsworth is also about to terminate his position with the Faculty of Agriculture, having been appointed Professor of Agricultural Chemistry and Head of the Department of Agricultural Science at Nottingham University.

Queensland

Mr. C. J. McKeon has resigned from the position of Director of Agriculture, Department of Agriculture and Stock, at the expiration of a period during which he was seconded to the Queensland-British Food Corporation, to take over the position of Food Production Manager in the Corporation.

Mr. A. Howard has come from New South Wales to take charge of the C.S.I.R.O. Food Preservation Laboratory at the Brisbane Abattoirs.

Mr. W. I. Nankivell has given up his C.S.I.R.O. soil survey work in Queensland to join the Horticulture Division of the Victorian Department of Agriculture.

Mr. W. W. Bryan, Senior Lecturer in Plant Industry, Queensland Agricultural High School and College, Lawes, has been appointed a Senior Research Officer within the Division of Plant Industry, C.S.I.R.O. and is stationed in Brisbane.

South Australia

Mr. E. A. Cornish has been awarded the degree of Doctor of Science by the University of Adelaide.

Mr. J. K. Taylor recently left Australia for Europe. With Dr. R. J. Best and Mr. R. I. Herriot he will attend meetings of the International Congress of Soil Science at Amsterdam.

Mr. R. W. Jessup has been appointed Senior Lecturer in Agronomy at the Waite Institute.

Dr. R. L. Crocker has resigned from the staff of the Waite Institute and has taken up duties as Associate Professor of Soil Morphology in the University of California.

Mr. J. V. Mertin has been appointed as Research Officer (Plant Quarantine) with the Department of Health and for the present is stationed in Adelaide.

Victoria

Mr. J. M. Ward retired from the position of Superintendent of Horticulture

last June after a conspicuous record of service in the Victorian Department of Agriculture. To mark the occasion a dinner was held in his honour and was attended by representatives of various departments and the horticultural industries.

Mr. P. S. Lang has passed the examination for the degree of Doctor of Philosophy at the University of Melbourne. Mr. Lang in conjunction with *Mr. N. M. Tulloh* and *Mr. B. V. Fennessy* carried out a survey of Western District sheep properties and submitted the report as his thesis for the degree. Mr. Lang is now concerned in pastoral operations at Lismore, Victoria.

Mr. C. G. Webb of The Weekly Times is at present in the United States of America. He expects to spend one term at the University of Missouri studying journalism and to return via the United Kingdom and Europe next May.

Mr. R. D. Croll, President of the Victorian Branch, is now Acting-Manager of Eagley Knitting Mills.

Mr. D. Shaw, formerly of the Division of War Service Land Settlement, is now with the Bureau of Agricultural Economics at Canberra.

COMMONWEALTH AGRICULTURAL BUREAUX

NEWS NOTES

Review Conference, 1950

The Review Conference in London concluded on July 15 and a provisional list of recommendations adopted by the Conference has now been received. The recommendations of general interest are:—

(a) The C.A.B. Organization provide an information service on scientific work in agriculture and forestry throughout the world;

(b) The headquarters of the Bureau of Biological Control should continue to be located in Canada;

(c) The new building planned for the Commonwealth Mycological Institute be provided immediately;

(d) The offer of the United Kingdom Government for the Agricultural Research Council to take over and maintain the Commonwealth Potato Collection be accepted;

(e) The establishment of a Bureau of Agricultural Economics;

(f) The Plant Expeditions' Committee be maintained as an informal consultative body and that a member of the staff of the Bureau of Plant Breeding and Genetics act as their Secretary.

At the time of the Conference, Ireland and Pakistan indicated their intention to continue membership of the C.A.B. organization. This had been in doubt.

Change of Official Correspondent

After many years service Dr. W. J. Wiley has resigned his appointment as Official Correspondent for the Bureau of Dairy Science. He has been succeeded by Mr. G. Loftus Hills, of C.S.I.R.O., Dairy Research Section.

New Publications

Recently received publications are:—

"The Production and Utilization of Silage" 1949—12/6.

"The Establishment of Vegetation on Industrial Waste Land" (1949)—12/6.

"Recent Advances in Fruit Juice Production" (1950)—18/9.

"Field Trials II: The Analysis of Covariance" (1950)—4/5.

These may be obtained from the C.A.B. Liaison Officer at 314 Albert Street, East Melbourne, C.2.

REVIEWS

WATER IN THE PHYSIOLOGY OF PLANTS

By A. S. CRAFTS, H. B. CURRIER and C. R. STOCKING

(Chronica Botanica Co., Waltham, Mass., U.S.A., Melbourne, N. H. Seward Pty. Ltd., 1949. 240 pp. Price $5.00).

This book is not the monograph on water in plant life for which physiologists are waiting; something which will replace Maximov's well-known but out-dated volume. It is "intended as a reference book" and its approach is clearly revealed by the authors: "we have **repeated** the minimum of material from the literature essential to a connected discourse." As a reference book it will undoubtedly be very valuable and it will replace all others on those aspects of water relations with which it deals. The authors are to be commended on the very thorough survey of the extensive literature which has been brought fully up to date in four pages of the Preface.

The first five chapters of this book deal with the structure of water, the properties of solutions, osmosis and the mechanism of osmosis. Although it is of course obvious that modern plant physiology is based on the physical sciences, one cannot help feeling that this introduction, which occupies 58 out of 208 pages of text, is pretentious and unnecessary. Most of this material can be found in text books of physical chemistry and it could have been summarised very shortly in an introductory chapter. The authors' attitude to this subject is revealed by their stateemnt (p. 55): "these values (of osmotic pressures) do not give the answer that the biologist is seeking, namely a picture of the underlying principles upon which the mechanism of osmosis is based." We prefer to think that it is the physical chemist who is seeking this answer, not the biologist, who has other fish to fry.

With Chapter VI the physiology begins, with "Intracellular distribution of water." Chapter VII deals with the osmotic quantities of cells and is particularly valuable for a good account of the measurement of these quantities. The authors follow the established American practice of preferring, for "suction pressure" the correct but clumsy "diffusion pressure deficit" contracted to the objectionable D.P.D.

Chapter VIII deals with Active cell water relations, IX with Uptake and movement, and X with Loss and Retention. In these three chapters the authors have been faced with a most difficult problem. There has been an abundance of research work, much of it inconclusive, but still worth reference, and only a few clearly established concepts have emerged. It seems to the reviewer that under the circumstances it would have been better to have attempted a clear synthesis of certain topics without continually referring to authorities, except possibly by index figures. Where there is, as yet, no general agreement, but merely a mass of conflicting evidence from work in progress, as in the subject of Active Absorption, one would prefer a classification of the material almost in tabular form rather than an attempt at a connected and vaguely critical account which only leaves the reader with a sense of frustration. Such is given, for example, on p. 159 "Pierce . . . tested the conductivity of frozen stem portions to gas by blowing through it. Under conditions of water deficit there **seemed** to be evidence that some of the elements were not filled with ice. Such a procedure **might** be faulty however, . . . furthermore, disturbance of forces of cohesion . . . **might** result in rupture."

While not discounting the very great value of this book as a reference for students, it is disappointing to find the authors evading a full discussion of such important topics as the diurnal march of transpiration, drought resistance and xerophytism, and the stomatal control of transpiration. This last subject occupies only twenty lines; there is a half-hearted attempt to deal with the laws of evaporation, but no application of these to the stomatal system and it is extraordinary to find that the work of Brown and Escombe is not even mentioned, nor are its modern developments discussed. The whole subject of water relations in plants still awaits a satisfactory exposition; for the botanist who sets out to provide it, this volume will be indispensable.

J. S. TURNER.

VERNALISATION AND PHOTOPERIODISM — A SYMPOSIUM

By D. E. MURNEEK, R. O. WHYTE and OTHERS

(Chronica Botanica Co., Waltham, Mass. U.S.A., N. H. Seward Pty. Ltd., Melbourne, Victoria, 1948. *pp.* 196, *Price* $4.50)

This publication is a useful survey of the research concerned with the physiology of flowering plants—a subject of major importance in crop production, and yet so far little understood in relation to the general metabolism of plants. Murneek of the University of Missouri, is well known for his work in the field of photoperiodism, and Whyte of the Commonwealth Bureau of Pastures and Field Crops, Aberyswyth, Wales, has been concerned with the general progress of research in vernalisation since his part in the Imperial Abstracts Bureau report on Lysenko's method of vernalisation in 1933.

Papers by research workers from America, Germany, Holland, India and England have been used to describe the progress made in this field. At present, the research on the nature of the change from the vegetative to the flowering state is based on two factors affecting the onset of flowering:— (a) the chilling of germinating seeds, and (b) varying lengths of day on older plants. These factors have been interpreted to mean either that the change from vegetative growth to flowering is due to a flowering hormone localised in the buds (hormonal theory), or to a complete change in metabolism (phasic development theory). Recent evidence of the devernalisation of vernalised seedlings suggests that a combination of these theories is possible. The nature of the hypothetical substances involved and the metabolic conditions under which they are produced are so far unknown.

Several papers are specially interesting. In his account of the research on vernalisation, Whyte states that the earliest note on the effectiveness of low temperature in changing "Winter into Spring Wheat" was by Kleppart of Ohio in 1857. Gregory and Purvis of the Research Institute of Plant Physiology, London, have been interested in the fundamental biological processes concerned with the response of growing seeds to vernalisation, and have shown the possibility of vernalisation of the seed before maturation in the plant. Murneek reviews photoperiodic research from 1920 when Garner and Allard demonstrated the potent effect of length of day, to the present interest in the effect of a particular range of wavelengths of light, the mechanism of photoperiodism and the effect of temperature. K. C. Hamner outlines the present evidence for the relation of hormones to vernalisation and photoperiodism.

R. H. Roberts and B. Struckmeyer of Wisconsin University deal with the anatomical changes associated with the onset of the flowering state, and show that there is a reduction of cambial activity even before the flower primordia are developed. S.M. Sircar of the Department of Botany, Calcutta University, describes the recent but extensive work done on tropical crops. Rice for instance has been found to flower earlier after a presowing high temperature treatment. One of the special supplements is by A. Lang of Tubinger, Germany, and deals with the inheritance of photoperiodic response in tobacco.

—Y. AITKEN.

ARE WE SOIL MANAGERS?

(International Harvester Company of Australia Pty. Ltd, 1950, *pp.* 95.)

The obvious signs of advanced wind and water erosion dotting our landscape today show us that we are not soil managers. These wind scalds, water gullies, sheet eroded hills and silted up dams are only a small part of the whole story. Only by a careful examination of production can we fully appreciate the decline in soil fertility that has resulted from the exploitation of farming practices in our generation and in those before us. It is the duty of all who are aware of this threat to our future prosperity to enlighten others and it is pleasing to find the International Harvester Company doing this in such a practical manner. The subject of this book is the principles and practices of conservation farming. It is not a work of popular science nor is it an advertisement, but it is a scientific approach to an important subject. Methods of maintaining and building up soil fertility and mechanical details of conservation engineering are outlined. Ample photographs, diagrams and tables accompany an excellent script. The book is a very worthy contribution to the advance of scientific farming in Australia.

K. H. HAYES.

THE GRAZING ANIMAL

By J. F. H. THOMAS

(Faber and Faber Limited, 24 Russell Square, London. 1949. pp. 173, Price 15/- sterling.)

Following the repeal of the Corn Production Act in 1922 and the consequent non-guarantee of cereal prices, there occurred in England during the next eighteen years, a swing towards livestock farming with a wide-scale reduction in tillage area. Until the outbreak of World War II the British farmer was able to purchase unrestricted supplies of imported animal feeding stuffs. This led to the development during the 1920's and 1930's of a system of livestock production based largely on the use of purchased feeding stuffs and farmers consequently neglected to fully develop the potential productivity of their own fields. Even in the 1930's there were many who saw the weaknesses in the system of husbandry of that period. The agrostologist was discovering new and better strains of herbage plants; new techniques in pasture establishment and fodder conservation were being evolved; animal nutrition and disease problems were being investigated more actively than ever before. It was a period of development which would eventually unite livestock management more closely with grassland husbandry.

The author has written of the problems associated with these new developments. He was born and bred to farming, took a graduate course in agriculture, held various posts in agricultural education for seventeen years and for the last ten years had farmed on his own account. With such a background the reader may be justified in expecting a balanced presentation of the subject. He will not be disappointed.

In the opening chapter the author points out that "For a century and a half into the wide mouth and capacious stomach of Britain most of the world's food exports have found their way; . . . . " but, "No longer have we the ability to flaunt our money bags at the counters of the world's food shops; we must and we can produce more in this country." Mr. Thomas draws on a lifetime's experiences and study to show how this increased production can be brought about. The story, and a convincing one it is, revolves round improved pasture production and more efficient utilisation of the pasture by the grazing animal. He suggests that "the bovine conception of Paradise must be a pasture which maintains a May-growth-type sward throughout the greater part of the year" and that the "cheapest way to feed stock is to permit them to help themselves". The reader is taken through many phases of modern grassland husbandry and the special problems associated with intensive stocking, the question of seasonal changes in production, the conservation of surplus fodder, the choice of herbage plants by animal and by man, the management of land and stock, problems of animal behaviour and many other interesting problems of the grazing animal.

Although this book has been written for the farmer in the Old Country it contains much information equally valuable to the farmer in more recently settled areas. The extension worker and the agricultural scientist also could not fail to appreciate the views and message which the author includes in this very readable book. Mr. Thomas mentions that "Farming is now my livelihood; it is also the way of life I have chosen to follow." It is obvious that he realises how worthwhile his choice has been and how clearly he can see the problems which must be overcome in effecting the closest liaison between successful livestock management and grassland husbandry.

M. C. FRANKLIN.

TURKEYS AND GEESE

By HERBERT HOWES

(MacMillan and Co. Ltd., London, pp. 166. Illustrated, Price 6/- sterling.)

This book is written essentially for those who wish to rear turkeys or geese as a sideline to normal farm production. While the author writes for British conditions most of his commonsense advice applies equally under Australian conditions.

On page 2 the author sets the tone for the rest of the book with—"It must not be assumed that the raising of turkeys is a task for everybody. As in other branches of poultry husbandry, success depends very much on the individual concerned with the undertaking. He must be keenly interested and be prepared to consider the matter as a business proposition. It is necessary to make certain that the essential equipment for carrying out the task is available. Unless this is provided losses will be heavy."

The chapter on "Diseases: Treatment and Prevention" is very much to the point with the emphasis on prevention rather than treatment. Chapters on feeding and marketing are not applicable to local conditions, but the principles are there. The remainder of the book is of direct practical value to the ordinary man to whom it is written in a readable style. The section on geese is welcome as it fills a need for those who may be interested in breeding this hardy bird, whether newcomers or experienced breeders.

IRENE J. STEWART.

DIGESTS

SOME ASPECTS OF THE TASMANIAN APPLE INDUSTRY

By F. W. WALKER

At the present there are approximately 22,000 acres growing apples in Tasmania with an annual production of over five and a half million bushels of fruit. There are over 2,000 growers and the capital value of the industry, including holdings, buildings and equipment, is in the vicinity of £8,000,000.

Apple trees were first planted in Tasmania over one hundred years ago, chiefly in the Huon, Hobart and Derwent Valley districts, seedling rootstocks being used. The greatest planting boom came towards the end of the nineteenth century when the Northern Spy rootstock was introduced to overcome the woolly aphis problem which had become serious. Additional districts were opened up in the Channel, Bagdad, East Derwent, Tamar Valley, Lilydale and Spreyton areas.

However, a large percentage of the plantings made at this time do not exist today. Many areas did not last ten years and have returned to scrub and grassland. Some land was unsuitable for apple growing and there, only small and stunted low-producing trees developed on the Northern Spy rootstocks. If these heavy plantings had been made on suitable rootstocks and in favourable soil conditions, the areas would now be in high production and probably would have doubled the present fruit yield for the State.

A large percentage of the present acreage is made up of trees over fifty years old, whilst the percentage in the thirty to fifty year age group is comparatively low. The percentage falling in the under thirty year age group is much below that desirable for the maintenance of present production levels. Over the next twenty-five years production will decrease considerably unless a regular re-planting programme is implemented, because many of the trees in the older age groups are already uneconomic. Unlike many other agricultural crops, where acreage and production can be increased or decreased in a two to three year period, at least ten years would be necessary to establish an apple orchard and bring it into profitable bearing.

Another problem arises in the utilisation of old land which in most cases cannot be economically replanted for several years. Many of the holdings are too small for economic farming and on such properties there is little or no additional land for rotational plantings.

Centralised packing houses are needed for efficient presentation of fruit for marketing. There is also a need for more extension work in the industry in relation to cultural practices, fertilizer treatments and pest control methods.

Mr. F. W. WALKER, N.D. Hort. (London), is a Horticulturist, Department of Agriculture, Hobart, Tasmania. This digest is from his Presidential Address to the Tasmanian Branch of the Institute on March 13, 1950.

THE AGRICULTURAL REVOLUTION IN THE UNITED KINGDOM AS A RESULT OF THE WAR

By C. W. STRUTT

The decline in the economic position of the United Kingdom was brought about by the destruction due to the war and the selling of overseas assets. Wartime conditions made it essential to make changes in the agricultural system. Although the average farm size in the United Kingdom was 78 acres there was a higher percentage of farms of over 125 acres in the United Kingdom than in any other European country. The relatively large size of British farms made it possible to implement changes quickly. Plans had been made before the war and when it started food and feeding stuffs were rationed. The Government did not attempt to control agriculture from White hall. An Agricultural Executive Committee was formed consisting of representatives from farmers, landholders, tenant farmers and workers. The United Kingdom was divided into Regions, Countries and Districts, each of which was allocated a production target. District Committees held meetings with farmers each year and allocated the target acreages. During the war two million acres of land was reclaimed for arable use, but the same amount was lost to the services for camps, aerodromes, etc.

Agricultural committees carried out a national farm survey which classified each farm as good, fair or poor. The good farmers sent in their cropping programmes each year and the fair farmers were given advice where necessary. District Officers and District Committees concentrated on the poor farmers who, if they failed to try and improve their methods, were dispossessed. During the war they had no right of appeal but as soon as war ended, provision was made for appeals to a highly qualified board.

After the war the agricultural committees continued and under the Agricultural Act of 1947, the Government guaranteed prices for 80 per cent. of farm produce twelve months ahead. The farmers had to agree to the right of dispossession and provisions were laid down for the maintenance of fertility of the land.

Under the Agricultural Holdings Act of 1948, landlord-tenant relationships have been defined. This provides security of tenure, makes provision for permanent improvements, allows for rent adjustments and makes provision for maintaining soil fertility.

The main functions of the Agricultural Committees in the post-war period have been setting production targets and striving to make the fair farmers good and the poor farmers fair.

MR. C. W. STRUTT is Argicultural Adviser to the High Commissioner for the United Kingdom. *This digest is from an address given to the A.C.T. Branch of the Institute on December* 13, 1949.

His Majesty's Colonial Service Nigeria

The position of Entomologist in the Malaria Service of the Medical Department, Nigeria, is now vacant. This post offers considerable scope for individual research, and for further specialised training in laboratory and field work.

Choice of appointment will be given, between three years' probation for permanent and pensionable employment, or short term contract, with slightly higher salary. The salary scale, including pensionable expatriation pay, is £660 to £1,300 sterling a year, the initial salary being determined by war service, and experience. Income tax is at local rates.

Quarters, where available, are provided at low rental. Free travel passages are granted for the officer and his wife. The tour of service is 18 months, and leave on full pay is granted at the rate of 7 days for each month of resident service.

Candidates must possess a University qualification, preferably B.Sc., with Biology or Entomolgy as a special subject. Also, experience in taxonomy of Culicidae would be an advantage.

Prospective applicants should write to Professor S. M. Wadham, Dominion Liaison Officer for Colonial Service Appointments, University of Melbourne, Carlton, Victoria.

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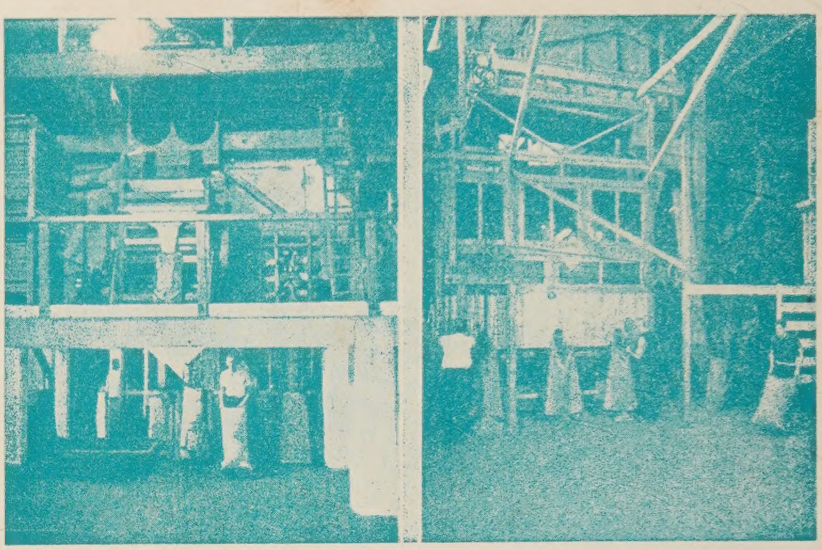

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